PRIVATIZATION AND REGULATORY OVERSIGHT OF COMMERCIAL WILDLIFE CONTROL ACTIVITIES IN THE UNITED STATES

A Dissertation

by

KIERAN J. LINDSEY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2007

Major Subject: Wildlife and Fisheries Sciences

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ABSTRACT

Privatization and Regulatory Oversight of Commercial Wildlife Control Activities in the United States. (August 2007)

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Urbanization decreases the amount of natural habitat available to wildlife but some species are able to adapt to and even thrive in human-dominated landscapes. When humans and wildlife live in close proximity the number of conflicts increase. Natural resource and agricultural departments were not designed to handle urban problems or the number of complaints that arise in urban areas, and the nuisance wildlife control (NWC) industry has developed in response to the unmet demand for assistance. Members of the wildlife profession have expressed concerns over the impact the nuisance wildlife control industry may have on wildlife, the public, and wildlife management, but no national studies were found that examined the size, growth, and/or economic impact of the industry. The most recent national reviews of regulation and oversight took place ≥10 years ago. This study examines 2 broad features of the NWC industry: 1) size and economic impact of the industry in the U.S. (e.g., number of businesses, annual sales revenue generated); and 2) the national regulatory environment. A total of 3,153 NWC businesses were identified in the U.S., and a conservative annual sales figure of $140 million was estimated for the wildlife removal services only. Changes in the regulatory environment from 1997-2007 were examined using a 10-category scoring system developed during an earlier study, and comparing the results of both studies. Changes were observed ($P \leq 0.05$) for 9 of 10 characteristics, and the average cumulative score rose from 2.20 to 4.28 out of 10.0.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

TABLE Page

CHAPTER I
INTRODUCTION: THE EVOLVING FIELD OF WILDLIFE DAMAGE MANAGEMENT

Throughout this document the term "urban" is defined as "an area generally consisting of a large central place and adjacent densely settled census blocks that together have a total population of at least 2,500 for urban clusters, or at least 50,000 for urbanized areas" (U.S. Census Bureau 2007); in other words, metropolitan areas and their associated suburbs. The U.S. is, and has been since 1945, an urban nation. Over 80% of Americans live in areas classified by the Census Bureau as "Metropolitan Statistical Areas" (MSAs).

This is not a study of wildlife damage control methods, justifications, or impacts, nor is it a study of public, agency, or nuisance wildlife control operator (NWCO) attitudes. Rather, it is a human dimensions of wildlife study that examines 2 broad characteristics of the nuisance wildlife control (NWC) industry: 1) the size and economic impact of the industry (i.e. number of businesses, historical growth rate, and annual sales revenue generated); and 2) the regulatory environment in which the industry operates.

Human-dominated Landscapes as Wildlife Habitat

The process of urbanization has affected humans and wildlife, and their interactions. Although urbanization, sometimes referred to as "sprawl," decreases the amount of natural habitat available to wildlife, with detrimental effects on many wild species, some are able to adapt to and even thrive in human-dominated landscapes. Raccoons (*Procyon lotor*), red foxes (*Vulpes vulpes*), white-tailed deer (*Odocoileus virginianus*), coyotes

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This dissertation follows the style of Journal of Wildlife Management.

(*Canis latrans*), and Canada geese (*Branta canadensis*) are just a few of the species that may occur at higher densities in human-dominated landscapes than in comparably sized rural areas (Harris and Rayner 1986, Fedriani et al. 2001, McKinney 2002, Prange et al. 2003). Food sources are plentiful for those species able to exploit garbage cans, pet food bowls, garden and landscaping plants, and wild bird feeders. Shelter is available in the form of both plant cover and human-built structures (Flyger et al. 1983). The water available in birdbaths, decorative ponds and fountains, pet bowls, and from sprinkler systems is plentiful and reliable. Under such conditions, wildlife populations may reach numbers unheard of in undisturbed habitats (Manski et al. 1981).

When humans and wildlife live in close proximity to one another the opportunity for problems increases and, as one might expect based on rising urbanization, the number of conflicts has been rising noticeably in the U.S. since the early 1980s (McKegg 1984, Acord et al. 1994, Organ and Ellingwood 2000): tree squirrels (*Sciurus* spp.) damage ornamental plants, dig up flower beds, consume foods intended for wild birds and, when they enter buildings, gnaw wood and electrical wires; raccoons den in attics and chimneys (often tearing up siding and shingles to do so), upset garbage cans, and their latrine areas may harbor a nematode (*Baylisascaris procyonis*) that poses a threat to human health; skunks (*Mephitis* spp., *Spilogale* spp., *Conepatus* spp.) and other rabies vector species may pose a health threat to humans and their companion animals; deer (*Odocoileus* spp.) browse on ornamental trees and shrubs and dash out onto roads, creating transportation hazards; beaver (*Castor canadensis*) girdle and kill trees, and beaver dams cause roads and yards to flood; bats (Order Chiroptera) roost in attics and walls, leaving piles of feces below; birds, including house sparrows (*Passer domesticus*), grackles (*Quiscalus* spp.), and European starlings (*Sturnus vulgaris*) create unsightly nests in man-made structures and deface buildings and vehicles with their droppings. The variety of wild vertebrate species that may come to be viewed as a nuisance is far more extensive than this brief list of examples may suggest.

Urbanization has changed American's attitudes and expectations concerning the natural world, and often urban residents are not prepared for the realities of living in

close proximity to wild animals (Flyger et al. 1983, San Julian 1987a). People may expect wildlife to recognize and respect both personal property and personal boundaries, and they may be truly astonished to discover that a striped skunk (*Mephitis mephitis*) is denning beneath their deck, or that a sharp-shinned hawk (*Accipiter striatus*) is using their backyard bird feeder as a songbird smorgasbord.

Human tolerance of wildlife is highly variable and often situational. One neighbor may actively encourage wildlife to visit by making supplemental food sources readily available, while the person living next door buys traps and poisons in an attempt to keep them away. Neighborhood residents may look forward to daily backyard visits from a single doe and her twin fawns, but their enjoyment may quickly turn to anger and frustration when a large urban herd comes to stay, decimating expensive landscaping.

The Public Sector's Role in Urban Wildlife Conflict Resolution

People living in metropolitan areas have been conditioned to rely on the public sector to provide support services for everything from wastewater treatment and street repair to domestic animal control. As a result, when conflicts between humans and wildlife arise, urban residents often expect free assistance from some level of government (Lindsey and Adams, 2006). There is precedent for this expectation; at a time in our history when most requests for assistance came from rural residents and were agricultural in nature, government agencies provided on-site capture and removal of problem wildlife, offered technical advice, and developed education materials (Curtis et al. 1995). But these government entities were not designed to handle urban wildlife problems or the sheer number of complaints created by urbanization.

State and federal agencies have long played an important role in administering laws and policies regarding nuisance wildlife control (Bluett et al. 2003). Legal authority for such regulation is vested in federal and state governments but often is divided among a confusing array of agencies. For example, structural pest control boards, and agriculture, cooperative extension, human health, and natural resource agencies are all commonly involved in human-wildlife conflict resolution (Bollengier 1981, Williams and McKegg

1987, San Julian 1987b, Berryman 1992), but the majority of animal damage control provisions are found in departments of agriculture (W. von Zharen, J.D., L.L.M., Texas A&M University-Galveston, personal communication).

Statutory authority for wildlife damage management was granted by the Animal Damage Control Act of 1931. The phrase "animal damage control" (ADC) has historically referred to the efforts of natural resource managers to reduce economic losses to agricultural crops and livestock caused by wildlife (Messmer 2000). In 1986, federal wildlife damage management responsibilities were transferred from the U.S. Department of the Interior's Fish and Wildlife Service (FWS) to the U.S. Department of Agriculture's (USDA) Wildlife Services (WS, formerly Animal Damage Control), a subunit of the Animal and Plant Health Inspection Service (APHIS). In addition to working with native wildlife, WS provides operational assistance (technical assistance and direct damage management programs) for invasive and exotic species intentionally or accidentally introduced outside of their native range. Although not all introductions result in established populations or have negative impacts, some have had adverse effects of native ecosystems and human activities (Bergman et al. 2000). Examples include: European starlings, house sparrows, cattle egrets (*Bubulcus ibis*), monk parakeets (*Myiopsitta monachus*), iguanas (*Iguana iguana*), brown tree snakes (*Boiga irregularis*), nutria (*Myocastor coypus*), and red fox. For reporting purposes, WS classifies a number of feral animals (domesticated animals living in an untamed state, e.g., free-ranging domestic cats, hogs (*Sus* spp.), and goats (*Capra* spp.)) as invasive species. Some invasive and/or exotic species listed above can be found in urban habitats.

In the last decade, WS has expanded beyond its traditional role to include resolution of wildlife conflicts in urban areas. Data from Wildlife Services' Management Information Service (MIS) from 1994 to 2003 showed that over 60% of projects conducted by the agency in response to requests for assistance from the public were categorized as "urban." Agency personnel assist with everything from helping individual property owners with removal of problem animals to reducing wildlife collision hazards at municipal airports (Wildlife Services 2004). In spite of the agency's efforts to change

with the times, however, the demand for assistance with urban wildlife conflicts is greater than funding and personnel resources can meet (L. Tschirhart, USDA Wildlife Services, personal communication).

The public frequently contacts employees of the Cooperative Extension Service (CES), a subunit within the USDA's Cooperative State Research, Education, and Extension Service (CSREES), with questions and requests for assistance on urban wildlife issues (Curtis and Decker 1990). Extension personnel recommend management techniques and provide educational information on wild, invasive, and exotic species but they do not assist with on-site removal of problem animals.

State departments of natural resources (DNRs) typically are responsible for management of the wildlife within their political borders, but the question of jurisdiction and responsibility for human-wildlife conflict resolution has, in some situations, strained the relationship between federal and state wildlife agencies (San Julian 1987b). The primary role of DNRs has been to regulate wildlife control activities through a licensing or permitting process (Hadidian et al. 2001). DNRs may be reluctant or unable to help the public with on-site urban wildlife problems, in part due to budgetary and personnel constraints (Flyger et al. 1983). Consequently, there has been a tendency to ignore this type of wildlife damage issue (San Julian 1987b) or leave resolution of urban conflicts to individual initiative (Hadidian et al. 2001).

Many counties and municipalities across the U.S. have animal control departments to handle domestic or feral animal conflicts, but most do not handle wildlife. Few local governments have established wildlife control departments (J. Mays, National Animal Control Association, personal communication). So while the demand for urban wildlife control services has increased, government support for on-site assistance, in the form of funding and personnel, has not kept pace (Curtis et al. 1995, Madison and Gipson 1997). As a result, non-governmental organizations (NGOs), including commercial NWC businesses, have stepped in to address the unmet demand for help (Bluett et al. 2003). The shift toward private, often profit-driven approaches to human-wildlife conflict

resolution appears to have evolved as a grassroots response to public demand as well as agency resource priorities and limitations (Lindsey and Adams 2006).

The Emergence of a Commercial Wildlife Control Industry

The general definition of a "pest" is any unwanted and destructive insect or other non-human animal; however, "traditional" commercial pest control companies (referred to throughout this document as simply "pest control companies" or "pest control industry") focus primarily on invertebrate species and commensal rodents. Also referred to as structural pest control, pest control service operators provide assistance, under contract and for a fee, to home owners, business owners, and government entities. The U.S. Department of Labor's Bureau of Labor Statistics (BLS) describes the nature of this work as locating, identifying, destroying, controlling, and repelling invertebrate species and commensal rodents using knowledge of the pests' biology and habits, along with pest management techniques such as chemical application, traps, and modifying structures (U.S. Bureau of Labor Statistics 2007). According to the BLS, pest control technicians "identify potential pest problems, conduct inspections, and design control strategies." Some technicians require a higher level of training, particularly if certain chemical products are used; these individuals are referred to as certified applicators. Fumigators are applicators who control pests using poisonous gases.

The pest control industry is composed of both specialist and generalist companies. For example, one of the more common specializations is the control of termites, which may require knowledge of fumigation techniques; removal of bee hives from within structures is another common area of specialization. On the other hand, nationally known pest control chains (e.g., Orkin, Truly Nolen, and Terminix), as well as many small-business pest control companies, provide control services for most common invertebrate pests (e.g., roaches, ants, spiders, fleas) and commensal rodents. Some also offer exclusion of and/or barriers against birds such as pigeons, house sparrows and European starlings (Clark 2003).

NWC can be viewed as part of the larger pest control industry even though it has developed largely outside of that field. Over the past quarter century, NWC has evolved from a few individuals who used their trapping skills and word-of-mouth marketing to generated a little extra income into a highly visible, albeit informal, subset of the pest control industry (Snetsinger 1983). NWC has gained so much attention of late that many pest control companies, including the national chains, have begun to add NWC to their menu of services.

Services offered by the NWC industry include trapping vertebrate species (primarily meso-fauna as well as mice and rats) and performance of an integrated variety of control, prevention and repairs (Clark 2003). In some cases, both pest and wildlife control businesses will also address problems with feral animals and exotic species.

The commercial NWC industry is separate and distinct from wildlife damage control services performed by government organizations. WS has a history and a policy of non-competition with the commercial pest control industry. WS Directive 4.220 states that the agency "will not provide a bid in response to an advertised request" and that "wildlife damage management services are provided only in response to requests for assistance."

In the majority of states, property owners have long been allowed to address human-wildlife conflict problems themselves. Based on the number of requests for assistance received by DNRs, and the seemingly vigorous growth of the NWC industry, it appears most people would rather pass the job off to someone else, even if doing so comes at a price. One of the earliest individuals to identify the full potential of the unmet demand for wildlife control services was Kevin Clark, a Michigan chimney sweep who was frequently asked to remove animals from the chimneys he cleaned. Clark found few individuals or companies that were willing to deal with problem wildlife, so in 1983 he founded Critter Control. The company, based in Traverse City, Michigan, incorporated and began franchising in 1987, and quickly grew to become the nation's leading wildlife control firm. In 2005, the company was the 21st largest pest control operation in the U.S.

Currently, there are over 107 Critter Control franchises in 38 U.S. states and Canada with sales revenues of $35 million annually (Whitford 2007).

Many others have since recognized the economic potential of providing wildlife control services. Recreational trappers across the country have discovered a way to transform their hobby into a paying job. In some cases these jobs are a sideline, something to bring in a little extra cash, but for others NWC is a full-time career. Since Critter Control was established, a second franchise operation specifically targeted at wildlife control, A All Animal Control based in Denver, Colorado, has been established.

One way to quantify the importance and impact of an industry is by determining its size (number of businesses and/or operators), value (sales revenue generated annually), and/or growth rate. There have been some published studies that mention or discuss the number and/or growth rate of NWCO licenses issued in a single state (Barnes 1993; Barnes 1995; Bluett, Hubert and Miller 2003) but a literature search failed to identify any publications in which the authors attempt to estimate the size of the national NWC industry. In the popular literature, an article in *Pest Control* magazine estimated the number of individuals working in the wildlife control industry at more than 10,000 (Whitford 2007), but did not discuss the methods by which the estimate was generated.

Understanding the public's willingness to pay for a particular service (e.g., resolution of a human-wildlife conflict) along with the amount they are willing to pay can provide insight into how the service is valued by consumers (Conover 2002). Some researchers have attempted to estimate the annual cost of human-wildlife conflict including: damage caused by a single wild species (Winter 1999); specific types of damage such as the impact of wildlife on air travel (Cleary and Dolbeer 2005); and wildlife damage in general (Conover 2002). One must keep in mind, however, that wildlife damage also has positive economic impacts in the form of sales revenue generated through wildlife control services provided for a fee, and very little is known about this side of the economic impact equation.

NWC industry sales revenue numbers, particularly for the Critter Control franchise, have begun to attract some media attention, but a literature search failed to uncover any

publications that explore the topic on a national scale. An article in the *Wall Street Journal* (Sterba 2002) claimed that "hundreds of companies… have sprung up to get in on the hundreds of millions of dollars now spent annually dealing with nuisance wildlife," but the author did not indicate the method used for determining the market value. The willingness to pay someone to make a wildlife problem disappear should probably come as no surprise given that Americans spent over $3 billion in 2001 alone just to feed wildlife as a recreational pursuit (National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) 2001).

Regulatory Oversight of NWCO Activities

Growth within the NWC industry has raised concerns about state DNRs and their role as regulators of: impact of removal and/or relocation of animals; the potential effect on human and non-human animal safety and welfare; ensuring competency and professionalism within the field; and other issues related to NWC activities (McAninch 1991; Craven et al. 1992; Brammer et al. 1994, Barnes 1998, Hadidian et al. 2002, Bluett et al. 2003). Members of the wildlife profession (Barnes 1998), the animal advocacy community (Hadidian et al. 2002), and the NWC industry (Critter Control 1991) have perceived the need for greater regulatory oversight and have called for reforms of state programs since the early 1990s.

Conversely, state wildlife agencies often have demonstrated a reluctance to work with wildlife-related industries and many NWCOs perceive governmental involvement to be oppressive to growth (Barnes 1998). The relationship between NWCOs and state DNRs often is unclear and inconsistent. Most DNRs are charged with the regulatory role in this relationship, but they also depend on commercial NWCOs to address requests from the public for assistance with human-wildlife conflicts that the agencies are either unable or unwilling to handle (La Vine et al. 1996). NWCOs may feel they are in an uncomfortable position since they are routinely asked by their regulatory agency to take care of a problem, then told how they can and cannot accomplish it (La Vine et al. 1996).

Six published studies have examined the role of DNRs in regulating the NWC industry; 2 studies examined the current laws and regulations of a single state (Bromley et al. 1993; Bluett et al. 2003), and 4 were national studies (Brammer et al. 1994; La Vine et al. 1996; Barnes 1998; Hadidian et al. 2001). Each examined at least some aspect of state regulations and/or policies related to oversight of NWC activities, often with inconsistent or contradictory results. Statutory authority, organizational structure, and tradition appear to vary widely among state agencies (Barnes 1997, 1998) and, based on the information received from DNR personnel in this study, remain in flux.

Study Justification

This study began with an extensive review of published literature, during which very few peer-reviewed publications on either of the 2 aforementioned characteristics of the NWC industry addressed in this study were found. The overwhelming majority of studies found during this search were published in non-peer reviewed wildlife damage conference and workshop proceedings; the exception, and also the most recent treatment of the subject, albeit at a state rather than national level, was a study on "Regulatory oversight and activities of wildlife control operators in Illinois" published in the *Wildlife Society Bulletin* (Bluett et al. 2003).

The most recent national reviews of state regulation and oversight took place 10 years ago (Barnes 1998, Hadidian et al. 2001) and the literature search for this study was unable to identify even a single paper that examined the size, growth and annual sales revenue generated by the NWC industry. Several authors have asserted that the NWC industry has been growing rapidly, and that it continues to do so (Curtis et al. 1995; Barnes 1997, 1998; Madison and Gipson 1997; Hadidian et al 2001, 2002). These authors have expressed concerns over the impact this growing industry may be having on wildlife, the public, and wildlife management professionals, but none have quantified industry growth on a national scale. This study has attempted to address the above-mentioned gaps in knowledge and understanding of the NWC industry.

Research Overview

The overarching goals of this 2-phase study are: 1) to describe the current NWC business and regulatory environments; 2) to identify trends within the industry and regulatory agencies; and 3) to develop recommendations for wildlife professionals, administrators, and policy makers based on the study findings.

A database of companies that provided NWC services, either as the primary business focus or as a sideline, was developed over a 6-month period during Phase I of this study. Using this database, along with information from previous studies (Barnes 1993, Curtis et al. 1995, Bluett et al. 2003), estimates of the number of NWC businesses, the historic annual growth rate of the NWC industry, and the annual sales revenues generated by NWC businesses in the U.S. were generated and are presented in Chapter II, along with study objectives, hypotheses, methods, results of statistical analysis, and a discussion of the study findings.

Phase II of the study, presented in Chapter III, is an examination and analysis of the national regulatory environment of 2007, and how that regulatory environment has changed over the past decade. Using the methodology and raw data from a 1997 review of state NWCO regulations (Hadidian et al. 2001), all 50 states and the District of Columbia were assigned scores for 10 categories of regulation identified as important to NWC stakeholders. Changes in category and cumulative scores are presented, along with study objectives, hypotheses, methods, statistical analysis results, and a discussion of the study findings.

Lastly, Chapter IV presents an overview of the study findings, management implications and recommendations, and suggestions for future research. A complete list of the literature cited within this document is provided beginning on Page 74. Appendix A is a summary of the NWC business database created in Phase I of this study and Appendix B is a table of the estimated annual NWC industry sales for 2006 by state and region. Appendix C is a table with the raw regulatory scoring data for 1997 and 2007 for all 50 states and the District of Columbia. Lastly, Appendix D is a list of nomenclature used within this document.

CHAPTER II

SIZE, GROWTH AND ECONOMIC IMPACT OF THE NWC INDUSTRY

Much of previous wildlife control research has focused on the magnitude and distribution of damage, stakeholders' tolerance levels, and management preferences for handling human-wildlife conflicts and oversight of NWCOs (Pomerantz et al. 1986, Conover 1997, Barnes 1998). Little detailed information has been published about the NWC industry—its size, growth rate, economic impact, and management implications. General descriptions of the NWC industry's growth in the published literature include "rapid" and "exponential" (Barnes 1998, Hadidian 2002) but data on specific attributes have been limited largely to analysis of a single state when they exist at all. Phase I of this study is an attempt to provide a more complete picture of the private sector's involvement in wildlife control, and its economic impact.

Human-wildlife conflicts have been increasing steadily for ≥ 2 decades, based on data compiled by state wildlife agencies, the Cooperative Extension Service, and Wildlife Services on the number and type of complaints (Madison and Gipson 1997, Bluett et al. 2003, Adams et al. 2006), as well as reports from the NWC industry (Barnes 1995). The role of the private sector has grown increasingly important. In the last 1980s the private sector began to recognize the opportunity created by a decrease in governmental on-site services combined with an increase in human-wildlife conflict complaints. Many individuals and firms entered the industry almost by accident; recreational trappers, invertebrate pest control operators, and others were asked to take care of human-wildlife conflicts when no other source of assistance was available. Their NWC "businesses" grew, first by word-of-mouth, then by more deliberate marketing efforts. From these inauspicious beginnings a new industry evolved that included part-time operators and full-time businesses (Braband 1995).

Little research has been done to increase understanding of the NWC industry, but a 1994 survey of 131 participants in an Eastern Nuisance Wildlife Control Operators

short-course, held in Lexington, Kentucky, provided some insight (Barnes 1995). Seventy-two percent of respondents identified themselves as NWCOs. The majority (90%) of these individuals considered their businesses successful, citing an increase in nuisance wildlife problems (18%) and a growing customer base (16%) as reasons for their positive assessment. Approximately half (48%) also operated a traditional pest control firm.

There are indications that the NWC industry, while still fairly young, is maturing. In 1992, the National Urban Wildlife Management Association (NUWMA) was incorporated as a professional organization for NWCOs, and the organization subsequently merged with the National Animal Damage Control Association (NADCA) in 1995. Another high-profile professional organization, the National Wildlife Control Operators Association (NWCOA), is actively involved in regulation and certification issues, and has several affiliated state NWC organizations. A magazine focused on the private sector, *ADC*, began distribution in 1993, although it is no longer available. A second, bi-monthly, magazine aimed at the NWC industry, *Wildlife Control Technology*, began publication in 1994.

Justification for Economic Impact Analysis

Barnes noted in 1995 that "little detailed information exists about the urban nuisance wildlife control industry," and not much has changed since that time. One 1991 study (Associated Market Research) examined pest control operators' involvement in NWC but did not obtain detailed information about the specific attributes of the NWC industry. Additionally, the study results may be unreliable because of a low (18%) response rate. Bluett et al. (2003) observed that generalities about growing numbers of wildlife conflicts and NWCOs underscored the need for regulatory oversight, but add little to policy makers' ability to assess potential administrative burdens associated with licensing requirements, the need for limitations on translocation and other activities, or the role of local governments and other partners. Agency personnel, policy makers, and administrators need more information on the size, growth, and economic impact of the industry if they are to meet their own natural resource management responsibilities,

provide adequate oversight of NWC activities, encourage greater professionalism, and reduce conflicts between NWCOs and wildlife professionals.

Phase I Study Objectives and Hypotheses

The objectives for Phase I of this study are: 1) quantify the number of NWC businesses operating in the U.S.; 2) estimate the average annual 10-year historic growth rate (AAGR) of NWC businesses in the U.S.; and 3) estimate the annual sales revenue generated by U.S. NWC businesses in 2006.

The number of human-wildlife conflict complaints has been increasing steadily (Decker 1987, Barnes 1993), but government support of on-site assistance has not kept pace (Curtis et al. 1995). The private sector has recognized the economic opportunity and potential created by this unmet demand for services (Clark 2003). Therefore, the following null hypotheses were proposed:

H_0 No significant increase in the number of urban wildlife control businesses in the U.S. will be observed from 1997-2007.

H_0 No significant geographic differences will be observed in the annual sales revenue generated by U.S. NWC businesses in 2006.

Size of the NWC Industry

An extensive literature review did not reveal any research that estimates the number of NWC business at the national scale, although several have reported on the number within a single state (Barnes 1995, Curtis et al. 1995, Bluett et al. 2003). Methods used for identifying NWCOs and NWC businesses have included reviews of state licensee lists (Bluett et al. 2003), annual reports submitted by licensed NWCOs (Curtis et al. 1995), and telephone directory searches (Barnes 1995).

Methods

Concerns about over-sampling arose during development of a NWCO database. Regulatory agency lists of licensed NWCOs may or may not include the name of an affiliated company or agency name, when one exists, and a single company may employ multiple NWCOs. "Yellow pages" telephone directories, on the other hand, list business names and rarely include information on either the owner (unless it is part of the company name) or the employees. Limiting the database to NWC businesses, rather than individuals, reduced the possibility of over-sampling. Since the focus of this study was the NWC industry, NWCOs who listed an affiliation with a government agency also were excluded from the database.

Development of the NWC business database took place over a 4-month period (1 Dec 2006 to 31 Mar 2007). Two methods were used to identify NWC businesses in all 50 states and the District of Columbia: 1) current NWCO licensee and referral lists were obtained, when available, from state wildlife agencies; and 2) additional NWC businesses were found using Internet searches of online business telephone directories (e.g., DexOnline, Superpages.com, YellowBook). Directory headings used were: 1) wildlife services; 2) wildlife relocation and protection; 3) animal trappers; 4) animal rescue and relocation; 5) pest control; and 6) chimney cleaning services. Searches were also done using the following keywords (based on an examination of business names on state NWC referral lists): animal, bat, beast, beaver, bird, creature, critter, geese, goose, kritter, nuisance, pest, raccoon, snake, trapper, trapping, varmint, varmit, wild, and wildlife. Additional searches included the NWCOA membership list (www.nwcoa.com), the Critter Control website franchise directory (www.crittercontrol.com), the Bat Conservation International website (www.batcon.org), and the Internet Center for Wildlife Damage Management (www.icwdm.org).

Many state licensee and/or referral lists, and even telephone directory listings, include a telephone number but no address. Missing business addresses were identified using a "reverse lookup" website with a search engine that identifies the address associated with a telephone number (www.anywho.com). One complicating issue is the

fact that many businesses now use cellular services as their primary business telephone number. Free reverse lookup searches generally do not identify addresses associated with cellular phone numbers. In such cases, the city in which a business was based was identified using the area code and exchange prefix, and the business was included in the database if there were no other companies with the same name within the same MSA.

Entries in the NWC business database include: a business name, city, state, zip code, phone number, and a source code. Telephone directory listings had to include the word "wildlife" or a type of wildlife in the business name, or specifically reference wildlife control services, to be added to the database. Once the search phase was completed, the database was examined entry by entry and duplicate listings were removed. This proved to be a tedious process because companies are allowed to purchase multiple telephone directory listings using variations on their business name; for example, it would not be uncommon for a company operating with the dba ("doing business as") "John Doe's Wildlife Control Service" to have additional directory listings using the name "JD's Wildlife Control Service," "John's Wildlife Control," or even "AAA John Doe's Wildlife Control Service" (telephone directories are organized alphabetically, so adding A's to the beginning of the business name increases the chance of being listed first). Moreover, companies may list their services under one or more directory headings (e.g., "Wildlife Removal," "Pest Control," and "Animal Rescue and Relocation").

In order for a business name to be listed more than once in any state there had to be information in the listing that indicated discrete physical locations existed. Every effort was made to be as accurate and inclusive as possible but there were surely NWC businesses active during the search phase of the study that were not included in the database. A summary of the raw data is located in Appendix A.

An SPSS for Windows (SPSS Inc., Standard Version, Release 14.0) database was created using the information gathered. Data were examined and analyzed using chi-square and one-way analysis of variance (ANOVA) tests, as appropriate, using the following characteristics:

- by region, using the FHWAR regions (2001; Figure 2.1)

- by states' population density (U.S. Census Bureau 1997, 2006)
- by number of MSAs (U.S. Census Bureau 2003)
- by urban population frequency for each state (U.S. Census Bureau 1990, 2000)

Region was chosen as possible determinant of variance because many NWC businesses operated in >1 state. Population-based characteristics were chosen because of the apparent connection, as identified in previous studies (Acord et al. 1994, Organ and Ellingwood 2000, Adams et al. 2006), between urbanization, population growth, and an increase in human-wildlife conflicts. It should be pointed out that for all statistical tests, except where noted, all states and the District of Columbia (the sample universe) are represented. As such, all tests of significance of difference are meaningful.

Results

A total of 3,153 NWC businesses were identified in the U.S.; Region 5 (East North Central) had the greatest number of NWC businesses (n = 872), Region 2 (Mountain) had the fewest (n = 101), and the mean number of NWC businesses per region was 350. Michigan had the highest number of NWC businesses (n = 452), Wyoming had the fewest (n = 0), and the mean number of NWC businesses per state (including the District of Columbia) was 62 (Appendix A). A map of the U.S. showing the distribution of the NWC businesses identified in this study can be found in Figure 2.2.

A summary of the results of chi-square and ANOVA tests are shown in Table 2.1. No difference in the number of NWC businesses was observed based on region (P = 0.34), on population density (P = 0.37), on states' urban population frequency (P = 0.29), or on the number of MSAs within a state (P = 0.10). However, region, population density, and number of MSAs were all determinants of variance (F = 2.24, P = 0.04; F = 864.31, P = 0.00; F = 3.67, P = 0.00; respectively).

Growth of the NWC Industry

Agency personnel, policy makers, and administrators use information on the historical and forecasted growth of wildlife-associated industries, when available, to evaluate the

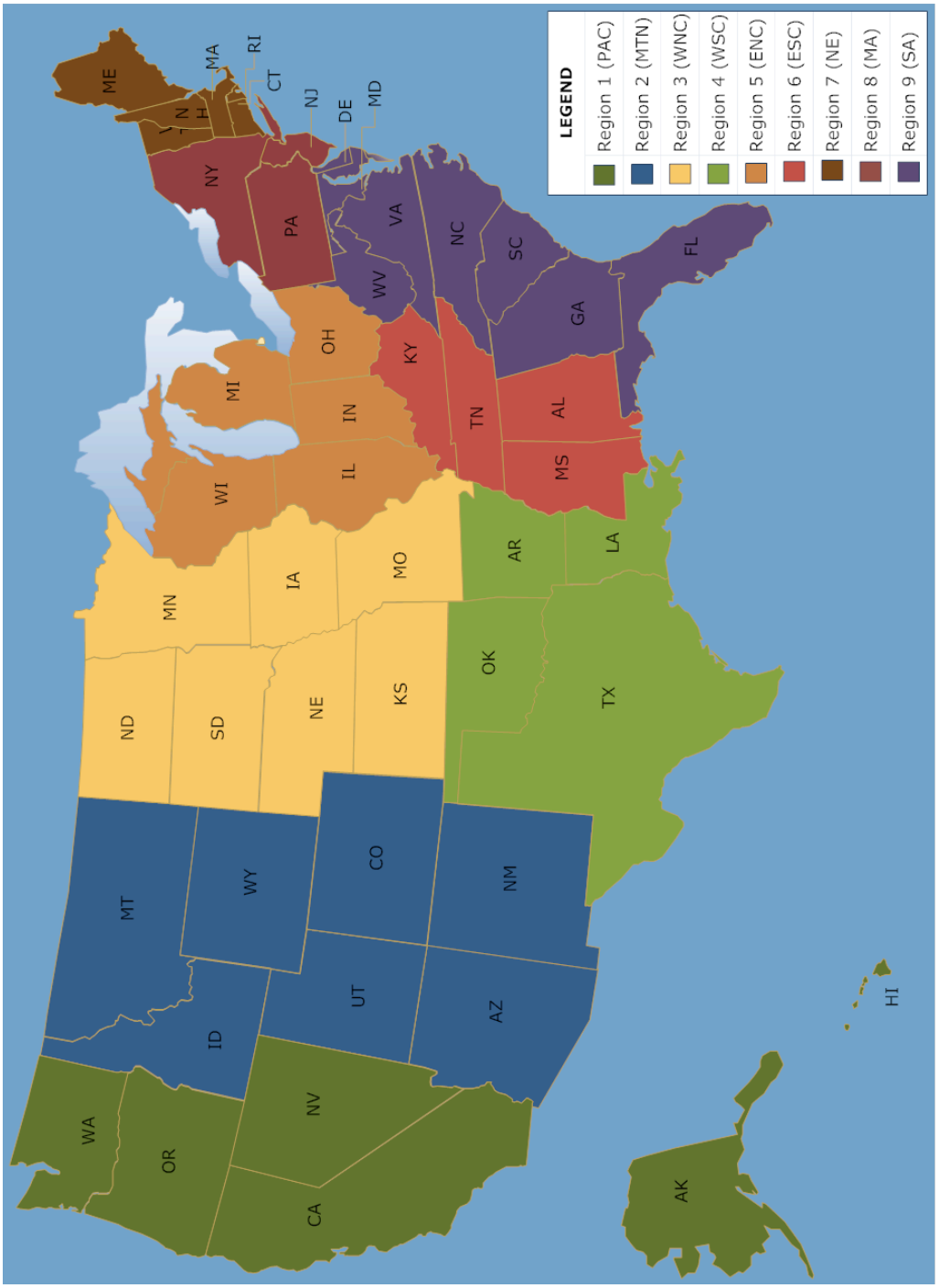

Figure 2.1. Map of 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) regions (U.S. Census Bureau)..

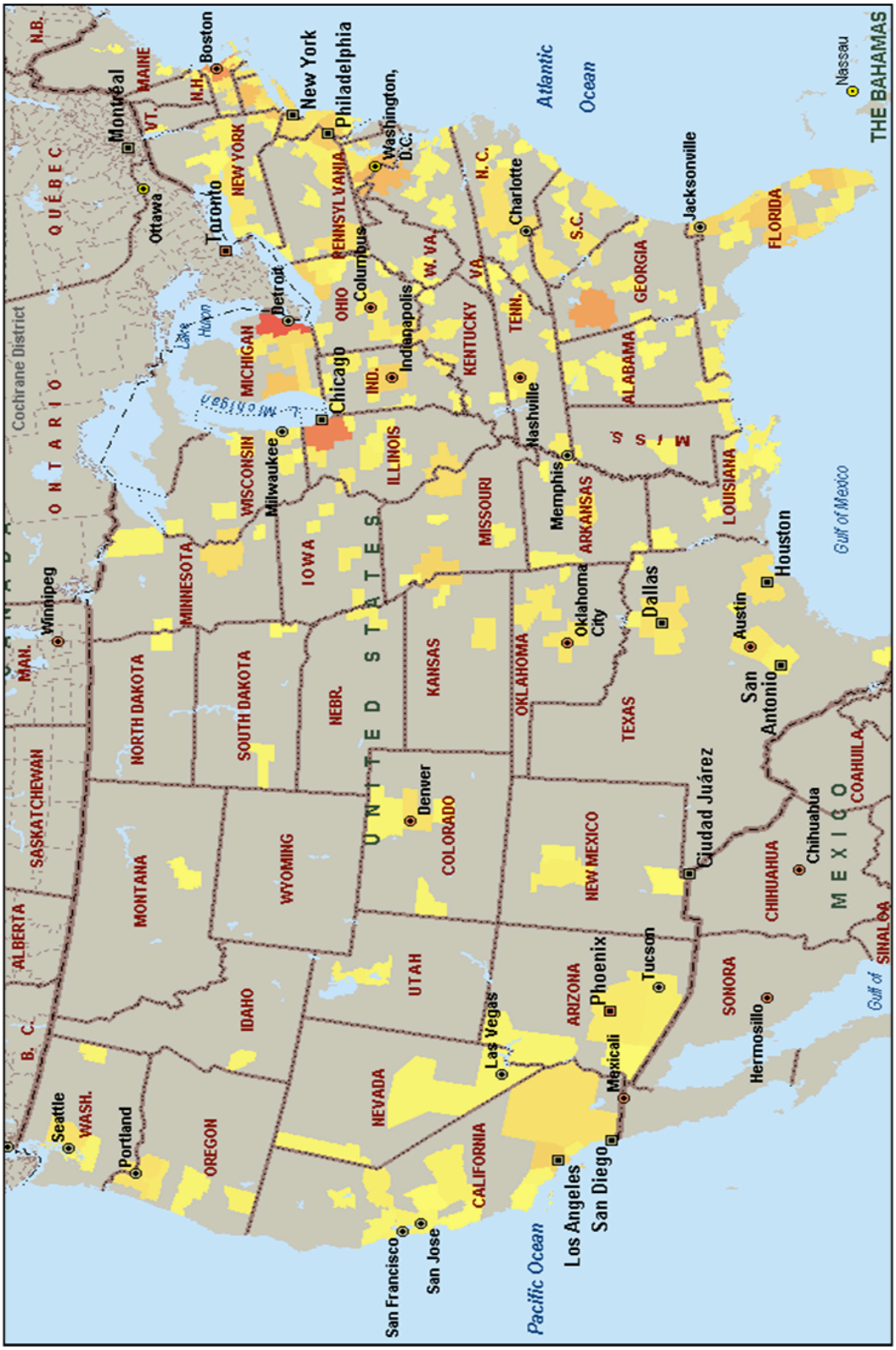

Figure 2.2. Distribution of NWC businesses identified in the United States.

Table 2.1. Analysis of NWC business data, using chi-square and one-way ANOVA tests, for 4 possible determinants of variance.

		# NWCO Businesses 2007		
	X^2	ANOVA		
Factor	*P*	**df**	***F***	***P***
Region	0.34	8	2.24	0.04
2006 Persons per Square Mile	0.37	47	864.31	0.00
2000 Urban Population Frequency	0.29	35	0.43	0.98
2000 MSAs	0.10	16	3.67	0.00

possible management implications of an industry's activity and make decisions regarding the need for regulatory oversight. Additionally, growth rate data can help administrators to anticipate and plan for possible industry demands on agency resources. The past doesn't predict the future, but it can indicate trends. Using historical growth rate data to forecast future growth is a common practice.

The federal government compiles data that may be helpful in establishing historical growth rates for some industries. For example, the BLS regularly publishes forecasts on the number of jobs that will become available within specific industries, and the Department of Commerce and Census Bureau compile data on the number of businesses within some industries, along with sales figures. Information is not available for every industry, however, and those that are newly established or have relatively small annual sales revenue figures as a percentage of gross domestic product (GDP) are less likely to be tracked.

In the case of an industry for which growth rate data are not available from government agencies, trade association publications, or other reference materials, one must attempt to determine the number of businesses that were active in years past using other methods. Telephone directories, in addition to their primary function as marketing tools, also serve as an archive of a city or state's business environment. Many libraries

maintain copies of old telephone directories on microfiche for use by historians, genealogists, and others, and these resources may prove helpful when one is attempting to identify changes in the number of active businesses within an industry over time, especially for well-established industries that have used the same directory headings for a decade or more. For example, consumers have learned to search under a single directory heading, "Pest Control Services," for assistance with ant, roach, termite, and rodent problems. A search of microfiche directories from as far back as the 1970s revealed that this same directory heading has been used for at least 30 years.

This method may be less effective, however, when the industry is still relatively young. Early in the development of an industry it is not uncommon to find businesses listed under the directory heading of a similar or related industry (e.g., NWC businesses listed under the "Pest Control Services" heading). As the industry matures, businesses may request new directory headings that are more specific to the services they offer. However, the directory headings they request may not be consistent from state to state or even city to city. Additionally, these businesses appear more likely to purchase listings under multiple directory headings, in part because consumers have not yet been trained how to search for businesses within the new industry. All of these factors increase the difficulty of identifying the number of businesses in an industry using archived telephone directories.

One may also attempt to develop a historical growth rate by examining in detail the growth of specific businesses within the industry. Franchise companies, because their business plans tend to be national in scale, may prove useful in this regard, but one must keep in mind that such businesses may not be an accurate representation of the industry as a whole.

Changes in the number NWCO licenses issued by states over specific time periods have been cited as indications of the industry's growth (Curtis et al. 1995, Bluett et al. 2003) and while certainly not perfect, this method of estimating historical growth rate is likely the most accurate and reliable. Additional investigation is needed, however, to improve the usefulness of historical growth rate figures.

Methods

The first step in developing a 10-year historical AAGR for the NWC industry was a review of archived telephone directories from 1997-2006 to determine which category headings were most likely to include NWC businesses. Based on the results, and because of observed variation in the way NWC businesses have been classified over the past decade (e.g., year to year, between states, and between cities within a single state), a decision was made to use two data sources when calculating AAGR: 1) telephone directory archives, and 2) historical NWCO license data from state agencies.

Preferably, both telephone directory archive data and historical licensing data for all 50 states would have been used to calculate the AAGR; however, historical licensing data was quite difficult to come by; in fact, in all but 2 cases (Regions 4 and 5) historical licensing data was found for a single state within each of the 9 FHWAR regions (one must keep in mind that only 20 states required NWCOs to be licensed in 1997). Therefore, the telephone directory archive search also was limited to the single state within each of the regions for which historical licensing data were available. In the 2 cases for which historical licensing data were available for >1 state within a region, a single state was chosen to represent the region. Because statistical analysis of AAGR was to be based on 3 population indicators (persons per mi^2, urban frequency, and number of MSAs), the states chosen to represent Regions 4 and 5 were the ones that most closely matched the regional mean for the same 3 population indicators.

An SPSS for Windows (SPSS Inc., Standard Version, Release 14.0) database was created and historical regional AAGR data were analyzed using chi-square and one-way ANOVA tests for the following characteristics:

- the regional mean population/$mile^2$ (U.S. Census Bureau 1997, 2006)
- the regional mean number of MSAs (U.S. Census Bureau 2003)
- the regional mean urban population frequency (U.S. Census Bureau 1990, 2000)

Population-based characteristics were chosen because of the apparent connection, as identified in previous studies (Acord et al. 1994, Organ and Ellingwood 2000, Adams et

al. 2006), between urbanization, population growth, and an increase in human-wildlife conflicts.

Results

Using data collected from archived telephone directories and historical licensing data, historical AAGRs were developed for a single state within each of 9 FHWAR regions (Table 2.2), and a mean 10-year historical AAGR of 7.6% was calculated. However, the historical AAGR for Region 1 (Pacific; 30%) is misleading because the total number of NWCOs identified for the representing state in 2007 was 5, compared to a mean of 94 for the other 8 regions (range = 25 - 196). In order to avoid reliance on an artificially high estimate of NWC industry growth, the calculation was redone without Region 1 for a mean 10-year historical AAGR of 4.8%. As one might expect from the historical AAGR, the increase in the number of NWC businesses in the U.S. from 1997-2007 (n = 1930 to n = 3153) was not found to be significant using a chi-square test ($P = 0.23$). None of the characteristics tested using one-way ANOVA were found to be determinants of historical regional AAGR variance (Table 2.3).

Table 2.2. Ten-year historical AAGRs for NWC businesses from 1997 to 2007, by region.

Region	State	AAGR	Region	State	AAGR
1	NV	0.30	6	KY	0.03
2	AZ	0.00	7	CT	0.00
3	KS	0.18	8	PA	0.06
4	AR	0.04	9	MD	0.03
5	IN	0.04			

Table 2.3. Analysis of regional historic AAGR rates, using chi-square and one-way ANOVA tests, for 3 possible determinants of variance.

	Regional Historic AAGR Rates			
	Pearson X^2	ANOVA		
Factor	*P*	**df**	***F***	***P***
Mean 2006 Persons/Mile^2	0.27	8	1.14	0.49
Mean 2000 Urban Frequency	0.29	5	0.44	0.80
Mean 2000 MSAs	0.48	6	1.30	0.50

Economic Impact of the NWC Industry

Previous research on wildlife control has focused, in large part, on the magnitude and distribution of damage; for example, 1 study estimated that households in the 100 largest metropolitan areas in the U.S. suffered an estimated $3.8 billion in damages caused by wildlife, despite spending $1.9 billion and 268 billion hours trying to solve or prevent human-wildlife conflicts (Conover 1997). Only 2 papers identified during a search of scientific literature included comments on the positive economic impact of wildlife control, in the form of job creation and sales revenue. Barnes (1995) asked participants in a NWCO short-course to complete a survey that included questions on the time spent working as a NWCO, annual billings, and fee structures. Of the 94 respondents who identified themselves as private NWCOs, 34% reported annual billings of >$50,000, and an additional 16% reported annual billings of $25,000 - $50,000. Curtis et al. (1995) estimated annual NWCO sales revenue for the state of New York from 1989-1990 of >$385,000 using data from annual activity reports and a very conservative price of $35 per complaint.

NWCOs across the U.S. provide a variety of services, including tasks directly related to wildlife (e.g., capture and removal, including emergency calls) and tasks related to property (e.g., installing exclusion barriers, repairing damage caused by wildlife, property inspection, conflict prevention counseling). An article in *Pest Control* magazine

(Whitford 2007) profiling Critter Control and its founder, Kevin Clark, reported annual sales, generated by more than 100 offices employing 450 people, of $35 million in 2006. The company offers 4 types of franchise territories:

- A-type territories are markets of ≤ 600,000 people (one-time fee of $18,000 plus 6% of annual sales revenues)
- B-type territories are markets of 600,000 to 1.2 million people (one-time fee of $24,000 plus 6% of annual sales revenues)
- C-type territories are markets of 1.2 to 1.8 million people (one-time fee of $30,000 plus 6% of annual sales revenues)
- D-type territories are markets of 1.8 to 2.4 million people (one-time fee of $36,000 plus 6% of annual sales revenues)

A company franchise information packet (Critter Control 2003) lists other requirements for starting a NWC business, including: $3,000 for traps, equipment, and office supplies; a business phone; and a pick-up truck (preferably half-ton). Critter Control provides classroom and field training, operation manuals, marketing support, $1 million in general liability insurance coverage, group purchasing discounts, newsletters, business consultations, and other support services.

A typical office reportedly averages >100 inquiries per month with a 50% sales closing rate, and generates an average gross income of > $100,000 per year (Critter Control 2003). A March 2006 press release from the company's annual franchise meeting honored several franchisees who had achieved over $1 million in annual sales. Clark estimated that 40% of sales revenues were derived from wildlife removal services, 30% from exclusion services and damage repair, 20% from inspection services, 5% from the use of rodenticides and insecticides, and 5% from work with municipalities (Whitford 2007).

Agency administrators and policy makers need more information on the economic impact of the NWC industry. For the purpose of this study, only capture and removal services will be considered in the estimate of the economic impact (sales revenue) of the industry.

Methods

Service industry sales estimates are typically more difficult to generate than consumer-goods sales estimates, but usable figures can be developed by multiplying demand for services (e.g., the number of conflict complaints) by price per job (e.g., the national average price charged by NWCOs for a specific service). Potential sources of price and demand data include government databases and publications, and internal records such as company sales figures (Kotler 2006).

The average price charged by NWCOs across the country for a basic service—removal of a wild animal from a structure—was calculated using both the Internet and telephone calls to NWC businesses. However, the exact number of complaints handled each year by NWCOs in the U.S. is unknown.

Two different methods were used to estimate demand for NWC services. Method I made use of the WS MIS database—a record of each human-wildlife conflict reported to the agency by a member of the public, along with the species involved, and the economic impact (loss). Because the MIS data did not include complaints to commercial NWCOs, it was understood that the estimate would be an under-sampling, but the WS records were the best national conflict report data available. WS provided access to data for the 15 most commonly recorded species for each FHWAR region from 1994 to 2003. Conflicts involving domesticated species (e.g., house cats, dogs) and wildlife species not commonly handled by NWCOs (e.g., deer, cougars, bears) were subtracted from the 10-year totals leaving only wild mesofauna and birds. Annual conflict estimates were calculated for each state. Estimated annual sales revenue figures were then generated for each state for 2006 by combining price and demand data (Appendix B). However, the annual national sales revenue figure calculated using Method I appeared unrealistic when compared to published sales data from the Critter Control franchise, which accounted for approximately 5% of the NWC business database, so a second method of estimating demand for NWC services was used.

Method II based demand estimates on published internal data from Critter Control (2003; Whitford 2007). The company's reported average sales per office of 600 jobs

annually was not thought to be representative of the "average" NWC business, most of which do not have the benefit of national marketing, some of which are part-time operations, and some of which are operated as a sideline to a traditional pest control business, so a more conservative estimate of 150 sales per year (approximately 3 removal jobs/week) per business location was chosen, and annual sales revenue figures were generated by state, by region, and nationally (Appendix B).

An SPSS for Windows (SPSS Inc., Standard Version, Release 14.0) database was created and annual sales revenue data were analyzed using chi-square and one-way ANOVA tests for the following characteristics:

- by FHWAR region (U. S. Census 2001)
- by population/mile^2 (U.S. Census Bureau 1997, 2006)
- by number of MSAs (U.S. Census Bureau 2003)
- by urban population frequency (U.S. Census Bureau 1990, 2000)

Region was chosen as possible determinant of variance because many NWC businesses operated in more than one state. Population-based characteristics were chosen because of the apparent connection, as identified in previous studies (Acord et al. 1994, Organ and Ellingwood 2000, Adams et al. 2006), between urbanization, population growth, and an increase in human-wildlife conflicts.

Results

Using a mean price per removal of $300 and the annual demand for NWC services generated using Method I (n = 42,238), an annual sales revenue figure of $12,671,400 was generated for the U.S. This estimate was quickly understood to be far too low—Critter Control alone reported wildlife removal sales of approximately $11 million in 2004 (Critter Control 2005) and $14 million in 2006 (Whitford 2007).

Using Method II, a conservative estimate of 150 sales per year (approximately 3 removal contracts a week) per business and a price of $300 per conflict generated national annual sales revenue for wildlife removal only in 2006 of approximately $140 million. This figure is meant to be conservative, but it does appear to be a reasonable

estimate. Statistical analyses are for sales revenue data based on estimates of demand using Method II (Appendix B).

A summary of the results of chi-square and ANOVA tests are shown in Table 2.4. No difference in annual sales revenue was observed based on region ($P = 0.34$), or based on the number of persons per square mile within a state ($P = 0.37$), states' urban population frequency ($P = 0.29$), or the number of MSAs within a state ($P = 0.10$). However, persons per square mile, and number of MSAs were determinants of variance ($F = 864.06$, $P = 0.00$; $F = 3.74$, $P = 0.00$; respectively).

Discussion

The first Phase I null hypothesis was accepted; the increase in the number of urban wildlife control businesses in the U.S. over the 10-year period from 1997-2007 was not found to be significant using a chi-square test ($P = 0.23$). The second Phase I null hypothesis was rejected; variations in current annual sales revenue generated by NWC businesses in the U.S. were observed between FHWAR regions ($P = 0.05$).

It should come as no surprise that characteristics such as population density and the number of MSAs within a state were determinants of variance for the number of NWC businesses, historical AAGR, and sales revenue generated—the more people there are living in a state, the more potential customers a business will have. Entrepreneurs who observe the potential for profit and the success of established businesses are more likely to start new businesses. Additionally, states that are highly urbanized are likely to have a higher incidence of human-wildlife conflicts.

Other researchers have reported much higher growth rates for the NWC industry based on increases in the number of NWCO licenses issued—Curtis et al. (1995) observed 309% growth in NWCO licenses in New York over an 8-year period (1986-1994), and Bluett et al. (2003) reported a 185% increase in licenses issued in Illinois, also over an 8-year period (1992-2000). One must keep in mind that these are not AAGRs. When the AAGR is calculated using these reported growth rates, the results are much closer to the estimated historical AAGR proposed in this study (approximately

21% and 8%, respectively). Additionally, the growth rate reported for New York is from over a decade ago. New industries typically have very steep growth rates, but as they mature growth slows and/or levels off.

Table 2.4. Analysis of regional historic AAGR rates, using chi-square and one-way ANOVA tests, for 4 possible determinants of variance.

	Regional Historic AAGR Rates			
	Pearson X^2	**ANOVA**		
Factor	*P*	**df**	**F**	***P***
Region	0.34	8	2.14	0.05
2006 Persons/Mile	0.37	47	864.06	0.00
2000 Urban Frequency	0.27	35	0.37	0.99
2000 MSAs	0.10	16	3.74	0.00

Throughout this study, the NWC industry has been described as relatively young, so it may come as a surprise to some readers that the estimated annual sales revenue generated by this industry in 2006 for animal removal alone has been reported here as $140 million, and with the caveat that this is likely a highly conservative estimate. When compared to the $6.6 billion in sales revenues generated by the pest control industry, however (U.S. Census Bureau 2002), it becomes clear that the NWC industry is still relatively immature.

Phase II of this study (Chapter III) will examine changes in regulatory oversight of NWCOs by state agencies over the past decade.

CHAPTER III

REGULATORY OVERSIGHT OF NWCO ACTIVITIES

State agencies play a key role in administering statutes, regulations, and policies that shape NWC programs (Bluett, et al. 2003), and they need clear operating authority to administer an oversight program (Slate et al. 1992). Statutes and regulations created by legislative bodies are codified, binding laws that can be found using traditional legal research channels. Policies are usually nonbinding agency guidelines intended to standardize agency procedures; often they are unpublished, subject to frequent revision, and may be difficult to obtain (Hadidian et al. 2001). Statutes, regulations, and policies all come into play as state agencies attempt to regulate NWC activities.

At the state level, legal authority for NWC activities may be divided among a variety of agencies, including natural resource, agriculture, and public health, as well as structural pest control boards. Early programs generally relied on informal cooperative agreements with private NWCOs to specify operational guidelines (McKegg 1984, Williams and McKegg 1987), but this approach became unwieldy as the number of wildlife conflicts and NWCOs expanded rapidly during the 1980s (Bluett et al. 2003). By the 1990s, members of the wildlife profession (Barnes 1997), animal advocacy groups (Hadidian et al. 2001), and the NWC industry (Critter Control 1991) began calling for reforms of state programs in response to the perceived need for greater regulatory oversight of NWCOs.

Justification for NWCO Regulation and Oversight

As the NWCO industry grew, various concerns were raised, including: 1) lack of biological monitoring; 2) safety of human and non-human animal welfare; 3) the impact of relocated wildlife on populations at release sites; and 4) the competence of NWCOs in managing wildlife conflict situations. Brammer et al. (1994) and Bromley (1995) called for a policy that would allow for the continued development of the NWC industry, while

maintaining state DNR oversight. Barnes (1997) responded by proposing a model program designed to allow state agencies to monitor and guide growth in NWCO activities. The model encouraged the privatization of NWCOs by formalizing it as a legitimate business. Agencies were encouraged to provide greater oversight by licensing NWCOs. In addition, agencies were encouraged to require all individuals, companies, or other entities involved in NWC to: 1) complete an education program and pass an examination in order to receive an operating license; 2) receive continuing education to maintain the operating license; 3) file annual reports delineating species, condition of animals, disposition of individual animals, release sites, and numbers of animals captured and released at individual sites; and 4) requiring liability insurance for NWCOs.

In 1997, Hadidian et al (2001) began a study of state NWC statutes, regulations, and policies by identifying 10 scoring categories of importance to wildlife management agencies and to the operation of the NWCO industry in relation to public interests and concerns. Five of the issues addressed by the Barnes (1997) model were included as scoring categories, along with several other issues of concern. The categories chosen for the study were: 1) license and permit requirements; 2) training, examination and experience prerequisites for licensing; 3) recertification; 4) reporting; 5) translocation; 6) humane treatment guidelines; 7) euthanasia (veterinary-approved methods of killing non-human animals); 8) consumer education and protection; 9) threshold of damage; and 10) use of integrated pest management strategies (IPM; a decision-making process that emphasizes monitoring and action using a blend of cultural, physical, and chemical methods to keep pest problems at an acceptable level of management).

Other studies have reported on the number of states that require a special license to operate a NWC business as well as some other regulatory characteristics (La Vine 1996 et al, Barnes 1998), but the Hadidian et al. (2001) study provided the most complete snapshot of the regulatory environment for NWCOs in the late 1990s. Using the same 10 categories and methodology in 2007 provided an opportunity to observe the regulatory changes that have occurred over a 10-year period.

Phase II Study Objectives and Hypothesis

The objectives for Phase II of this study were: 1) to describe the NWC regulatory environment (statutes, regulations, and policies) for all 50 states and the District of Columbia in 2007 by assigning scores based on the 10 categories developed and used by Hadidian et al (2001); 2) to test possible determinants of variance in the regulatory scores assigned to states in 2007; 3) to identify and analyze changes that have occurred at the state level in the regulation of NWCOs between 1997 and 2007; and 4) to test possible determinants of variance between the regulatory scores from 1997 and 2007.

Urbanization and the growing number of NWC businesses in the U.S. may be a driving force in the demand for increased agency oversight from outside the public sector as well as from within the agencies. Changes in regulation of the NWC industry should be evident in the scores assigned to states using the 10 previously identified categories. Therefore, the following null hypothesis was proposed:

H_0 No significant increase in the number of states that require a license to conduct commercial nuisance wildlife control activities will be observed from 1997 to 2007.

Methods

In January 2007, requests for information on NWC regulations, statutes, and policies were sent to 50 state governors and the mayor of the District of Columbia. Missing information was obtained on state agency websites and using online legal databases. Phone calls were made to state agencies for clarification as needed. States were assigned scores based on the categories used by Hadidian et al (2001) in 1997. A request for the raw data from the 1997 study was granted, and the scores were entered into an Excel file. The lead author was consulted for instruction on the scoring methods used in 1997 so that they could be repeated. New scores were assigned and entered into the existing Excel file (Appendix C; Table 3.1).

Table 3.1. A summary of state NWC regulation scores, by category, for 1997 and 2007, and chi-square test results.

	License		Prerequisite		Recertify		Report		Translocation		Euthanasia	
	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07
Sum	20.0	35.5	6.5	16.0	3.0	6.5	20.0	37.0	25.0	46.0	10.5	20.0
Mean	0.39	0.70	0.13	0.31	0.06	0.13	0.39	0.73	0.49	0.90	0.21	0.39
Std.D	0.49	0.45	0.26	0.33	0.24	0.33	0.48	0.44	0.50	0.30	0.30	0.34
$X^2(P)$	0.00		0.00		0.00		0.00		0.17		0.00	
	Humane Guidelines		Threshold of Damage		Consumer Protection		IPM		Total			
	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07		
Sum	8.0	16.5	6.0	18.0	6.0	12.0	7.0	10.5	112.0	218.0		
Mean	0.16	0.32	0.12	0.35	0.12	0.24	0.14	0.21	2.20	4.27		
Std.D	0.31	0.31	0.24	0.39	0.33	0.40	0.28	0.30	2.24	2.18		
$X^2(P)$	0.00		0.29		0.00		0.05		0.12			

An SPSS for Windows (SPSS Inc., Standard Version, Release 14.0) database was developed using the 1997 and 2007 regulation scores. Data were examined and analyzed using the chi-square test to determine any significant change in states' regulation scores between 1997 and 2007. Possible determinants of variance were analyzed using one-way ANOVA for following characteristics (Table 3.2):

- by FHWAR region (U.S. Census Bureau 2002)
- by states' population density (U.S. Census Bureau 1997, 2006)
- by number of MSAs in each state (U.S. Census Bureau 2003)
- by urban population frequency for each state (U.S. Census Bureau 1990, 2000)
- by the number of NWC businesses based in each state

Region was chosen as a possible determinant of variance because it is commonly used in many studies that are national in scope. Population-based characteristics were chosen because of the apparent connection, as identified in previous studies (Acord et al. 1994, Organ and Ellingwood 2000, Adams et al. 2006), between urbanization, population

Table 3.2. One-way ANOVA tests of 1997 and 2007 regulatory scores for selected characteristics.

	Scoring Categories															
	License				Prerequisites				Recertification				Reporting			
	1997		2007		1997		2007		1997		2007		1997		2007	
Factor	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***
Region	1.92	0.08	0.48	0.86	0.68	0.71	0.95	0.49	0.96	0.48	2.12	0.06	1.82	0.10	0.47	0.87
1997, 2006 Persons per mi^{2*}	0.71	0.75	1.22	0.51	1.68	0.38	0.87	0.66	0.00	0.10	0.71	0.75	1.42	0.44	1.17	0.53
1990, 2000 Urban Population Frequency*	1.34	0.27	1.79	0.11	0.78	0.74	0.75	0.77	0.86	0.66	0.77	0.75	0.79	0.73	2.12	0.06
1990, 2000 MSAs*	0.83	0.64	1.46	0.17	0.82	0.65	1.18	0.33	0.76	0.72	0.40	0.97	0.78	0.70	1.65	0.11
# of NWCO Businesses 2007	n/a	n/a	1.84	0.14	n/a	n/a	1.40	0.28	n/a	n/a	1.03	0.51	n/a	n/a	3.80	0.01

	Translocation				Euthanasia				Humane Guidelines				Threshold of Damage			
Factor	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***
Region	2.34	0.04	1.24	0.30	1.53	0.18	1.48	0.19	0.96	0.48	1.12	0.37	1.42	0.22	1.42	0.22
1997, 2006 Persons per mi^{2*}	1.56	0.41	10.16	0.00	2.28	0.27	0.48	0.62	0.54	0.85	1.19	0.52	0.65	0.78	0.91	0.64
1990, 2000 Urban Population Frequency*	0.89	0.63	0.86	0.66	0.83	0.69	0.86	0.65	0.56	0.92	0.40	0.99	2.16	0.05	1.04	0.49
1990, 2000 MSAs*	0.57	0.88	1.36	0.22	0.93	0.55	0.40	0.97	1.64	0.11	1.18	0.33	1.17	0.34	0.72	0.76
# of NWCO Businesses 2007	n/a	n/a	0.81	0.70	n/a	n/a	0.99	0.54	n/a	n/a	1.84	0.12	n/a	n/a	1.50	0.24

	Consumer Protection				IPM				Cumulative Score			
Factor	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***	***F***	***P***
Region	1.41	0.22	0.72	0.67	1.57	0.17	1.37	0.24	2.28	0.04	0.86	0.56
1997, 2006 Persons per mi^{2*}	0.00	0.10	0.98	0.61	0.45	0.90	2.28	0.27	3.15	0.19	2.69	0.23
1990, 2000 Urban Population Frequency*	0.78	0.74	0.68	0.83	0.71	0.80	1.58	0.17	0.73	0.79	1.37	0.26
1990, 2000 MSAs*	1.34	0.23	3.31	0.00	0.45	0.95	0.33	0.99	0.77	0.71	1.31	0.25
# of NWCO Businesses 2007	n/a	n/a	2.12	0.09	n/a	n/a	0.63	0.86	n/a	n/a	1.83	0.14

growth, and an increase in human-wildlife conflicts. Lastly, the number of NWC businesses in each state was chosen because it seemed that regulation might follow a rise in the visibility of a particular industry. It should be pointed out that for all tests, all states and the District of Columbia (the sample universe) are represented. As such, all tests of significance of difference are meaningful.

Results

The results of the data analysis for states' regulatory scores in 1997 and 2007 are discussed in detail, by category, below.

Licensing

Issuing a license or permit to an individual or business was the primary means by which states regulated NWC activities in both 1997 and 2007. In all but 2 cases, the state DNR oversees NWCO activities; in Texas, the Structural Pest Control Board is the oversight entity, and California Structural Pest Control Board licensees are exempt from even the state trapping license requirement administered by the California Department of Game and Fish. State NWCO permits or licenses exempt the holder from standard "wildlife-taking" laws including regulation of seasons and bag limits. Florida and Utah do not issue a permit or a license, but they do require commercial NWCOs to register with the agency. North Carolina does not require a permit or license, but the required certification is more similar in scope to a permit than to a registration.

States with rules or regulations requiring a permit or license to conduct commercial NWC activities received a score of 1.0. A score of 0.5 was assigned to states that require only registration or, in the case of New Mexico, require a permit for trapping furbearers only. States that did not require a permit, license, or registration received a score of 0.0. North Carolina received a score of 1.0 in 1997 and its regulations have not changed substantially; therefore, it received a score of 1.0 in 2007 as well.

In 1997, 20 states (39%) required a permit or license to practice commercial NWC for a mean score of 0.39; by 2007, 34 (68%) states required a permit or license and another 3 (6%) had more lenient requirements, such as registration or a permit for furbearers only (Figure 3.1, Figure 3.2, Table 3.1, Appendix C) for a mean score of 0.70.

A change in the number of states requiring a NWCO permit or license was observed ($P = 0.00$) from 1997-2007 using the chi-square test (Table 3.1). None of the 5 characteristics tested (region, persons/mi^2, urban population frequency, number of MSAs, number of NWC businesses) was found to be a determinant of variance for states' licensing requirement scores in either 1997 or 2007 using ANOVA (Table 3.2).

License Prerequisites

States received a score of 1.0 if formal NWC training was required to receive a license or registration. States received a score of 0.5 if applicants were required to have previous experience handling NWC issues, were required to pass an NWC examination, or to pass a background check in order to receive their operating license.

In 1997, only 2 states (4%) received a score of 1.0 and 9 states (18%) received a score of 0.5 for a mean score of 0.13 (Figure 3.3, Appendix C). In comparison, 5 states (10%) received a score of 1.0 and 22 states (43%) received a score of 0.5 in 2007, for a mean score of 0.31 (Figure 3.4, Appendix C). A change in states' scores for license prerequisites was observed ($P = 0.00$) from 1997-2007 using the chi-square test (Table 3.1). None of the 5 characteristics tested was found to be a determinant of variance for states' licensing prerequisite scores in either 1997 or 2007 using ANOVA (Table 3.2).

Recertification

States that mandated continuing education for a license, permit, or registration renewal received a score of 1.0. Only 3 states (MA, NC, and WV) required NWCOs to receive continuing education in 1997 (6%), while 6 states (14%) (IN, ME, NC, NH, VA, and WV) received a score of 1.0 in 2007. Massachusetts received a score of 0.5 because

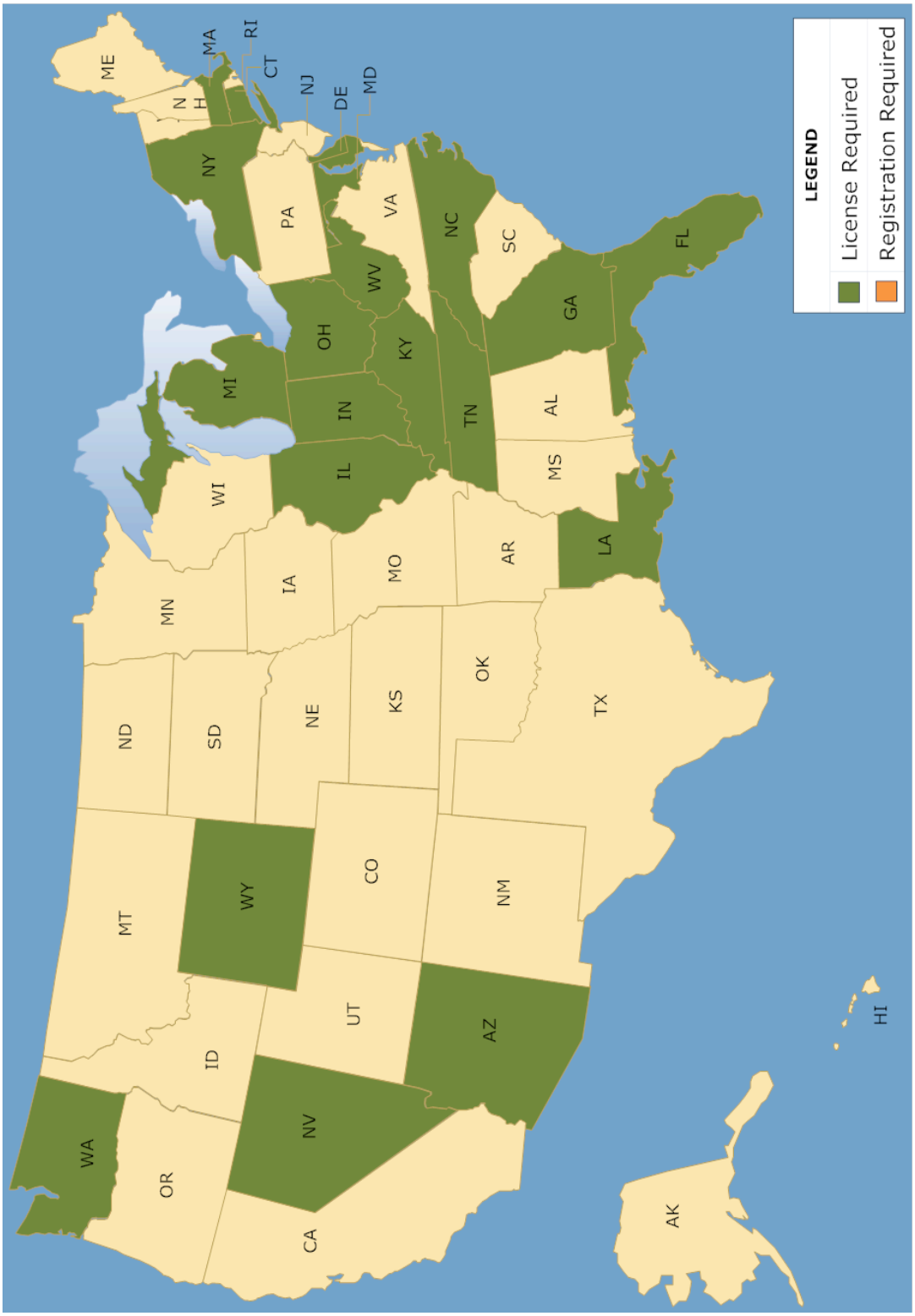

Figure 3.1. States with license or registration requirements in 1997.

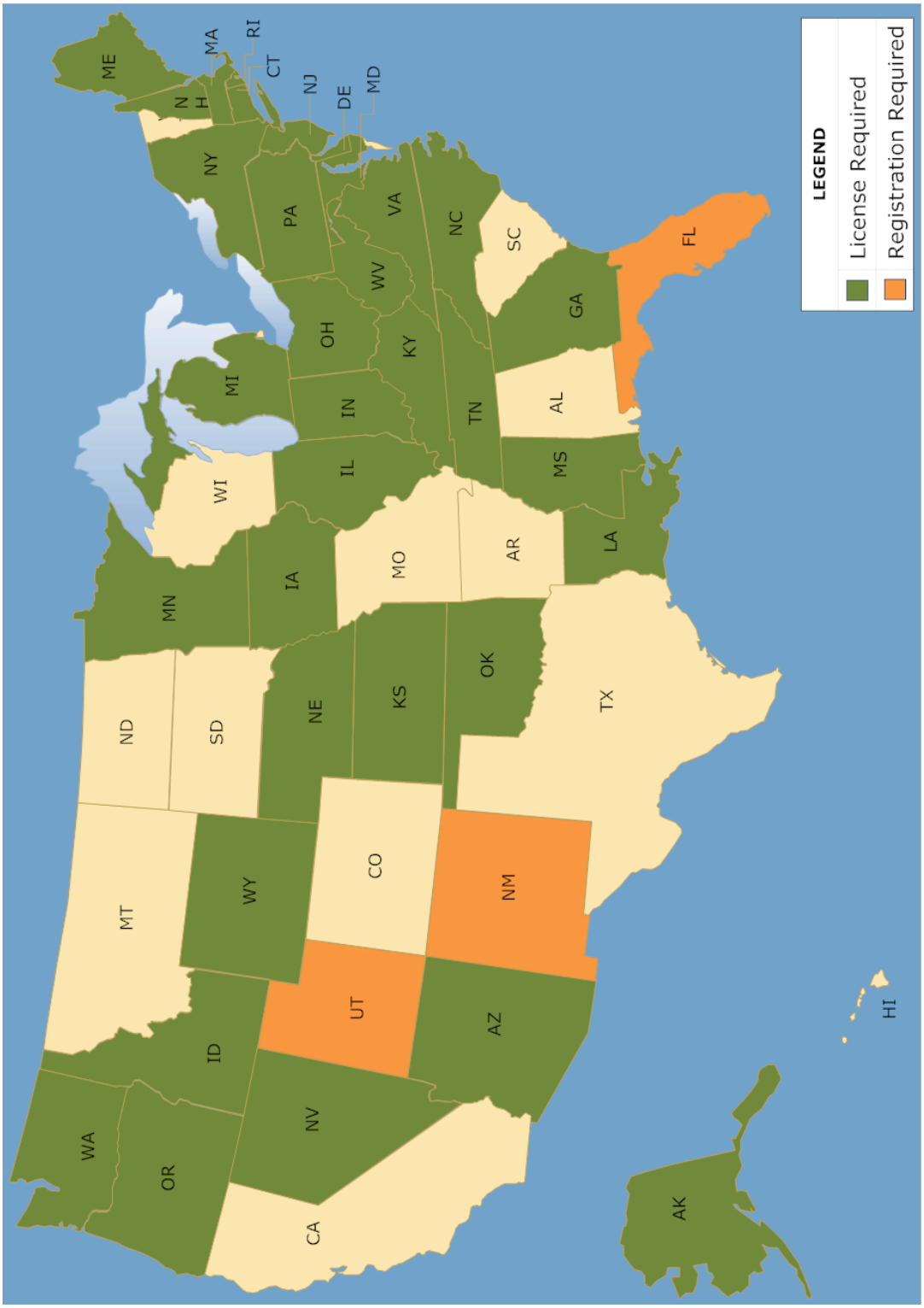

Figure 3.2. States with license or registration requirements in 2007.

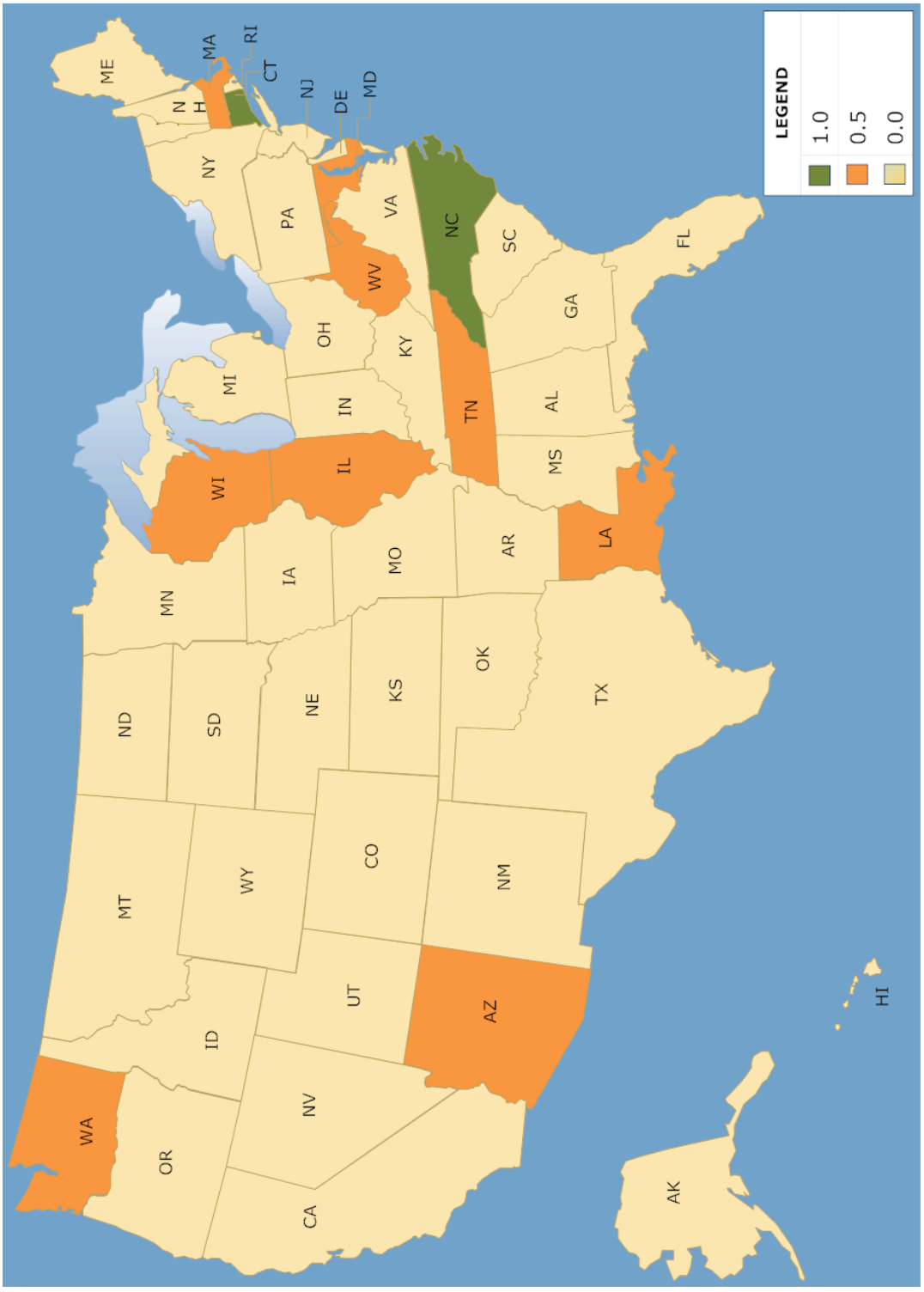

Figure 3.3. State license prerequisite scores for 1997.

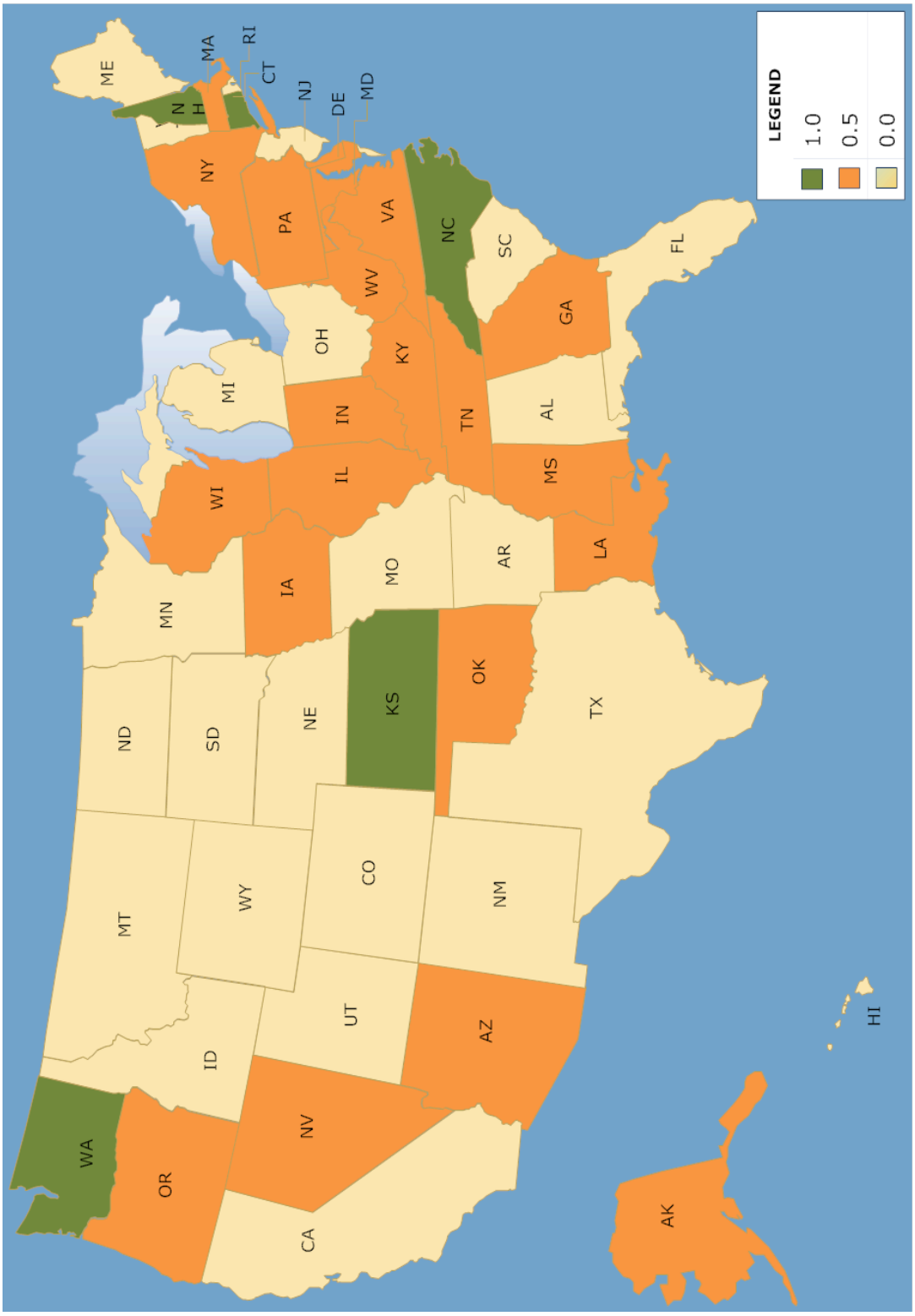

Figure 3.4. State license prerequisite scores for 2007.

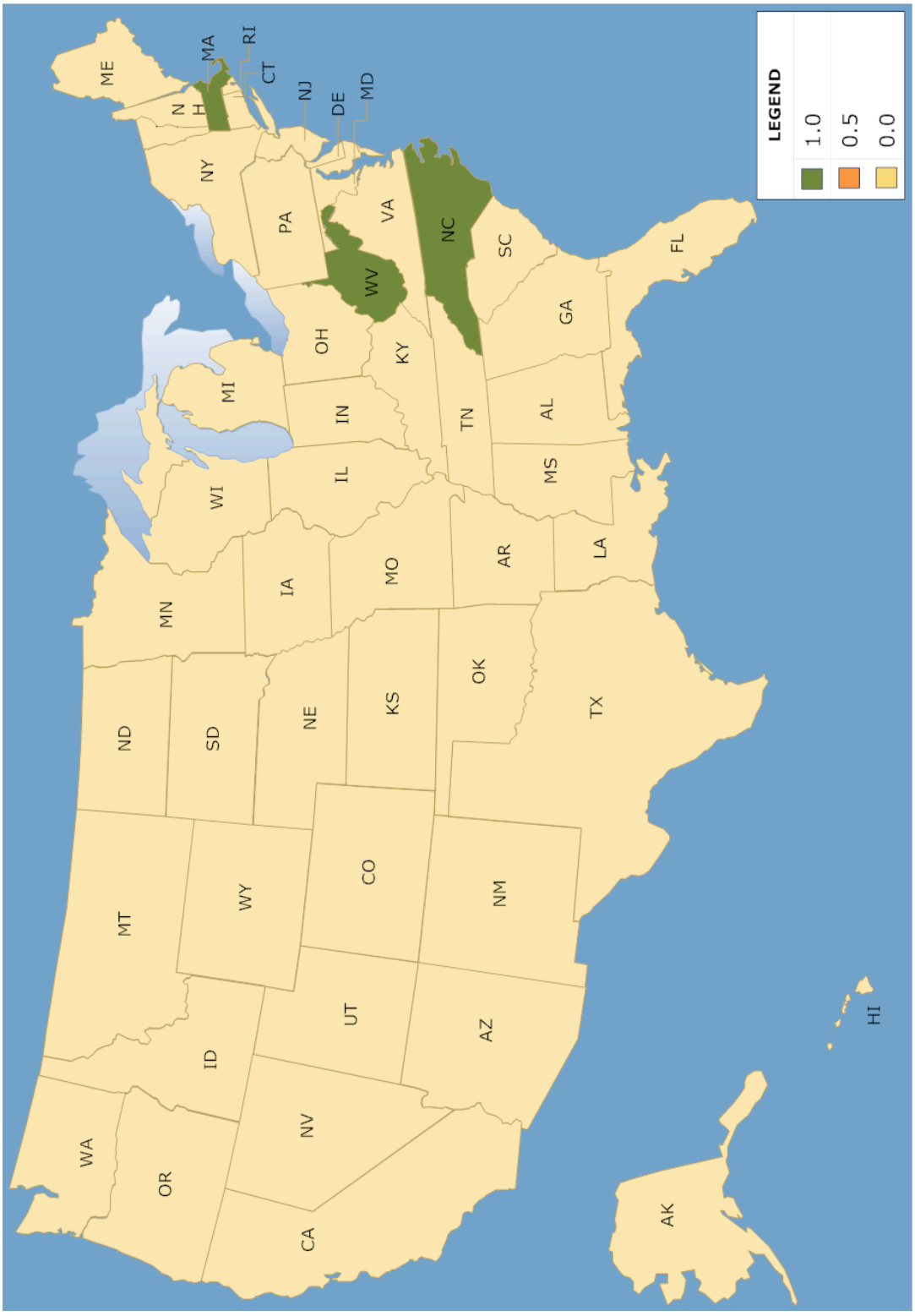

Figure 3.5. State license recertification scores for 1997.

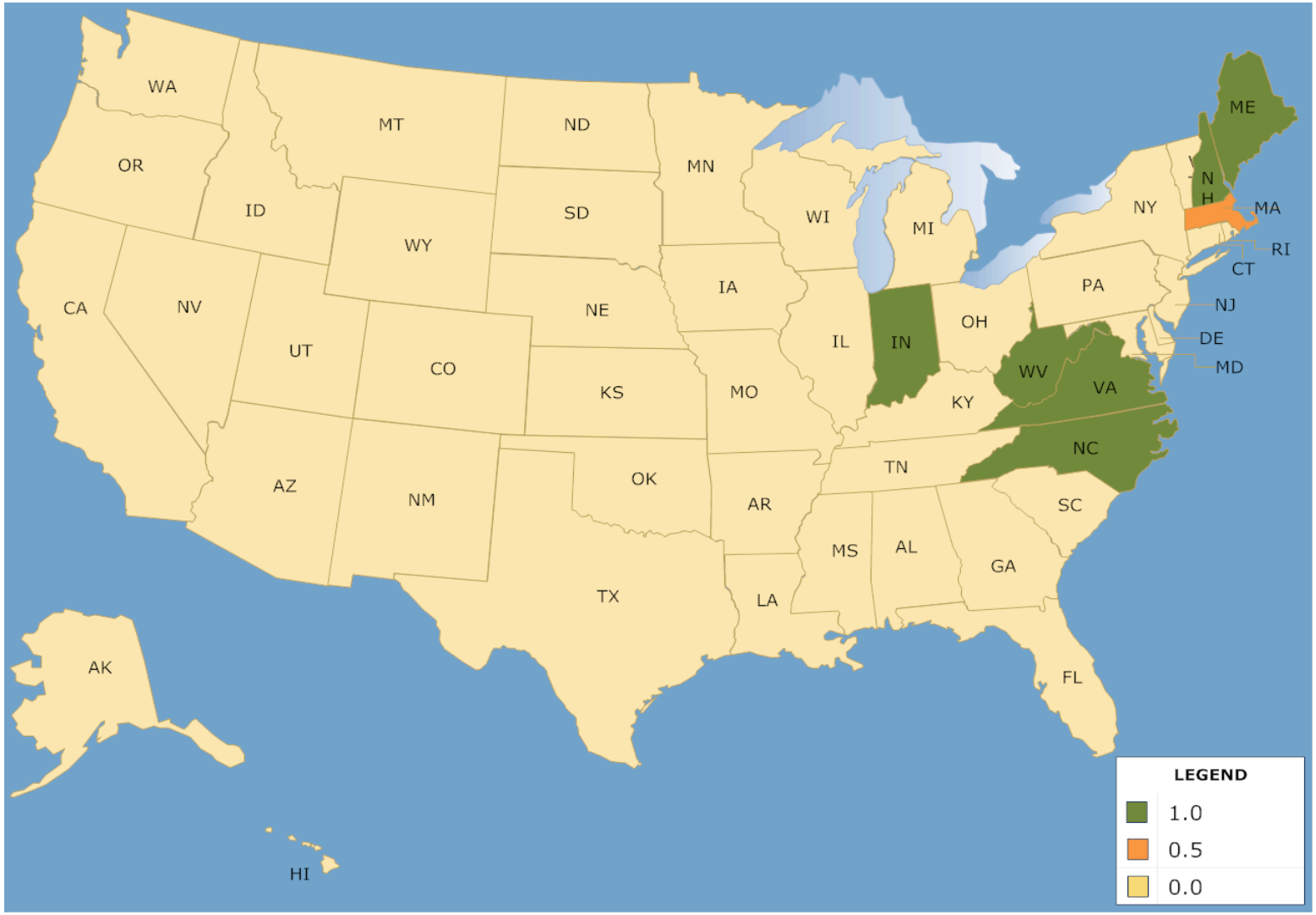

Figure 3.6. State license recertification scores for 2007.

Massachusetts received a score of 0.5 because NWCOs there must take a general trapper safety course rather than NWC-specific training. The mean score in 2007 was 0.13 (Figure 3.5, Figure 3.6, Table 3.1, Appendix C). A change in states' scores for recertification was observed ($P = 0.00$) from 1997-2007 using the chi-square test (Table 3.1). None of the 5 characteristics tested was found to be a determinant of variance for states' recertification scores in either 1997 or 2007 using ANOVA (Table 3.2).

Reporting

States that required submission of a written report of NWCO activities received a score of 1.0. States with other types of reporting requirements, such as placing a telephone call to the agency following a control action, received a score of 0.5, and those states without any reporting requirement received a score of 0.0. The 1997 study found 19 states (37%) required written reports and 2 (4%) had other reporting requirements, for a mean score of 0.39 (Figure 3.7, Figure 3.8, Table 3.1, Appendix C). In 2007, 36 states (71%) required written reports and 2 (4%) had established some other form of reporting, for a mean score of 0.73.

A change in states' reporting scores was observed ($P = 0.00$) from 1997 to 2007 using the chi-square test (Table 3.1). The number of NWC businesses was found to be a determinant of variance for states' 2007 reporting scores ($F = 3.80$, $P = 0.01$); none of the other 5 characteristics tested was found to be a determinant of variance in 1997 or 2007 using ANOVA (Table 3.2).

Translocation

States that addressed the issue of transporting and/or relocating nuisance wildlife in regulations or policy, either to allow or disallow, received a score of 1.0; those that did not address the issue received a score of 0.0. Twenty-five states (49%) addressed translocation in 1997, compared to 46 (90%) in 2007 (Figure 3.9, Figure 3.10, Table 3.1, Appendix C).

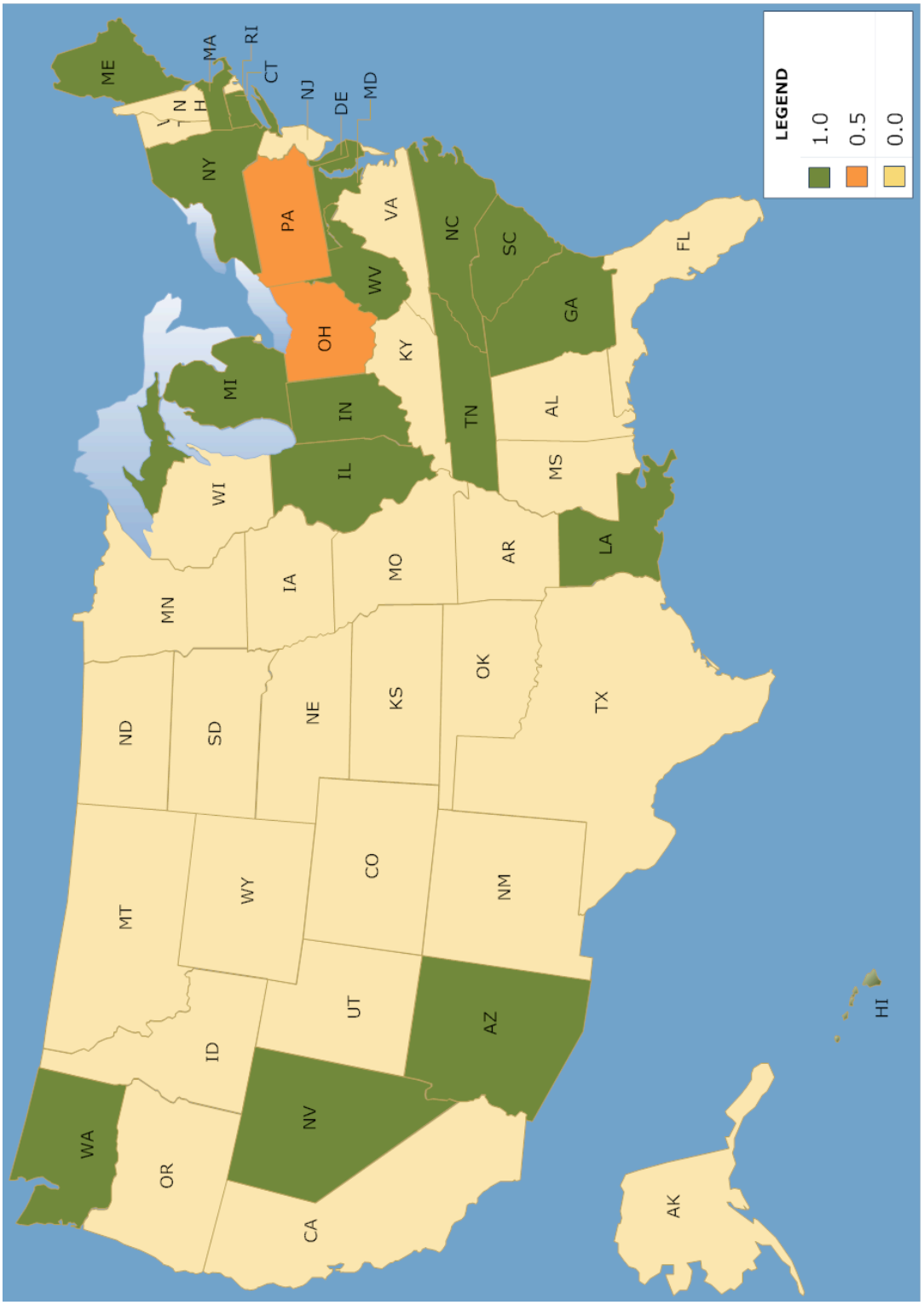

Figure 3.7. State reporting scores for 1997.

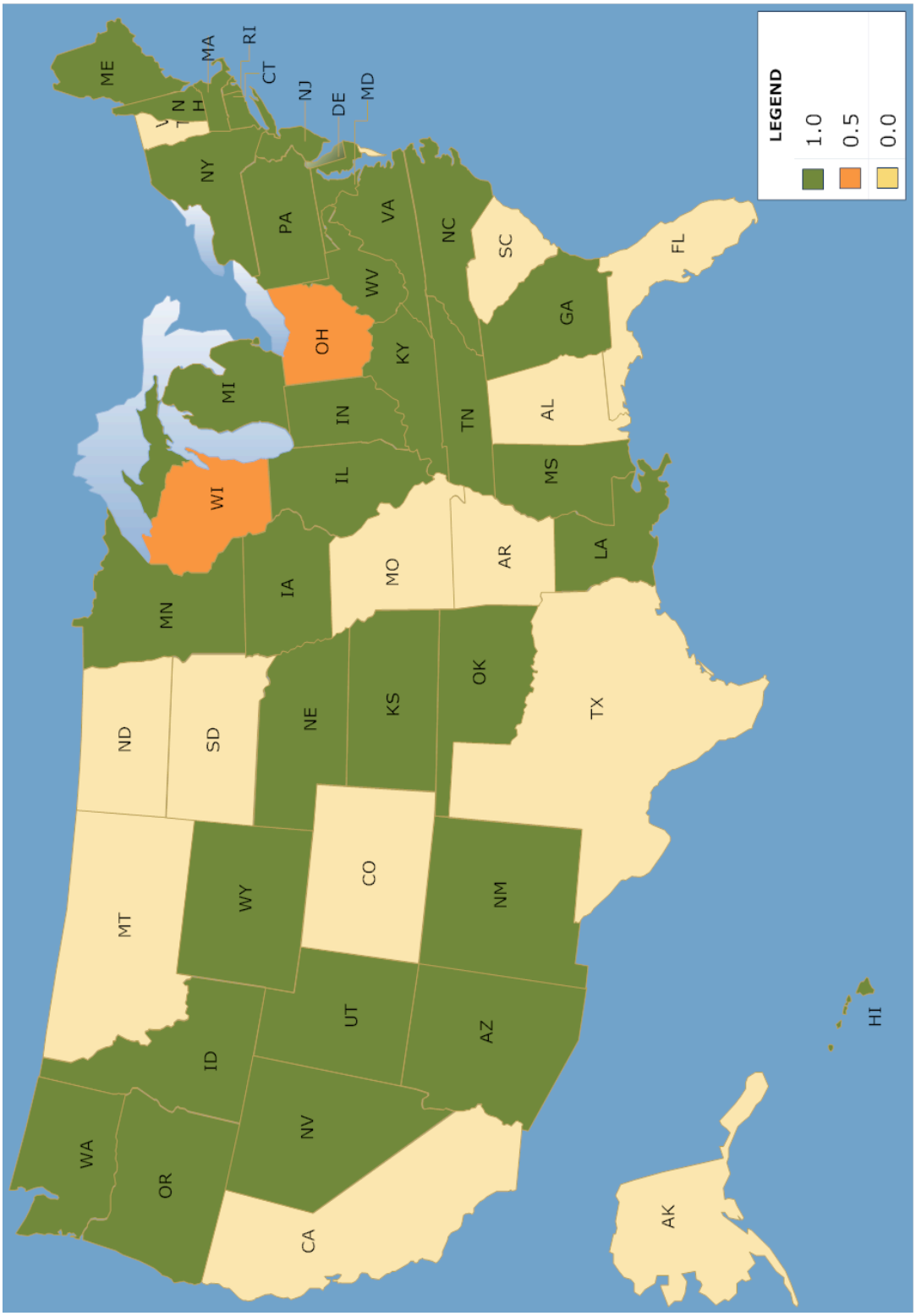

Figure 3.8. State reporting scores for 2007.

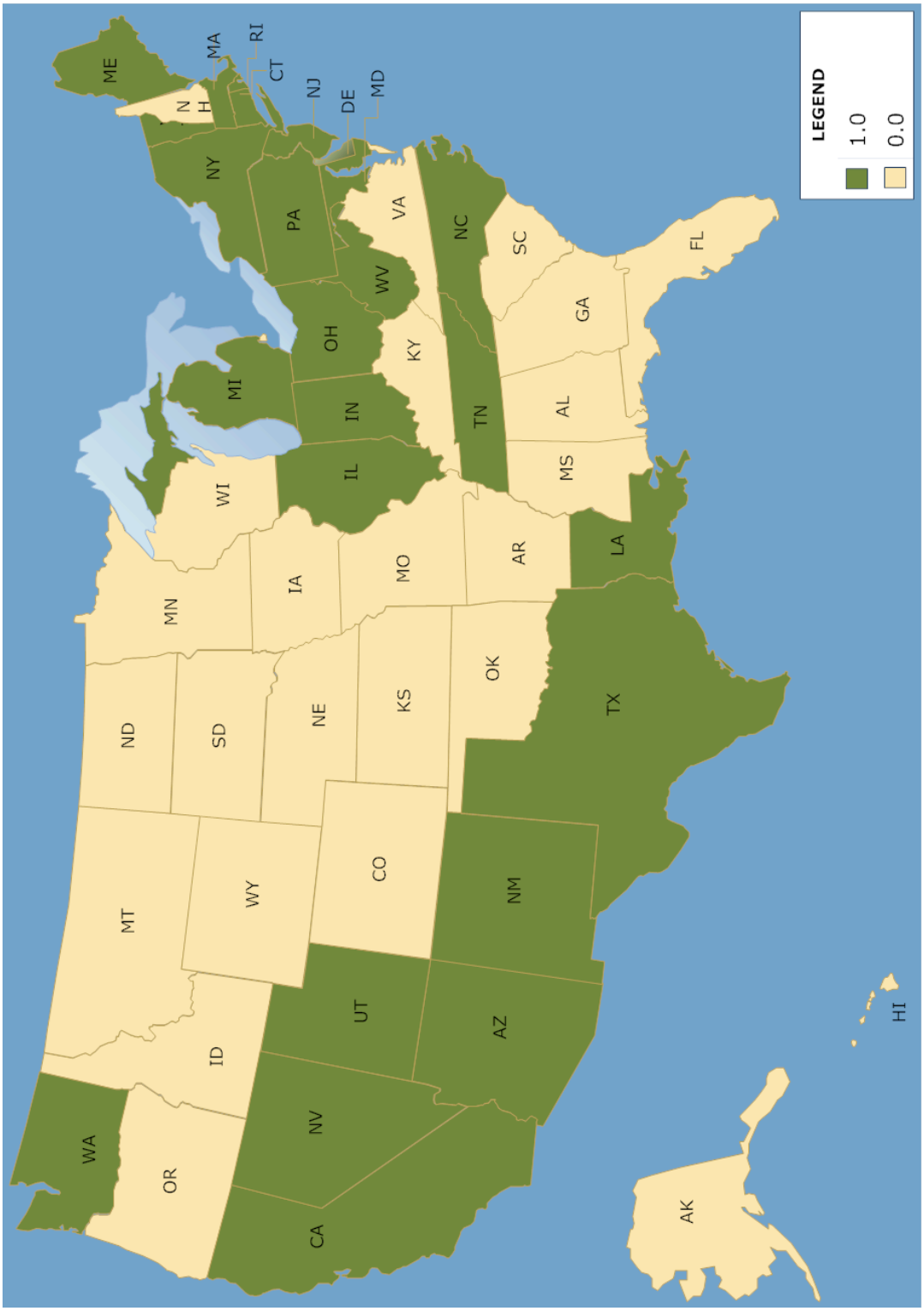

Figure 3.9. State translocation scores for 1997.

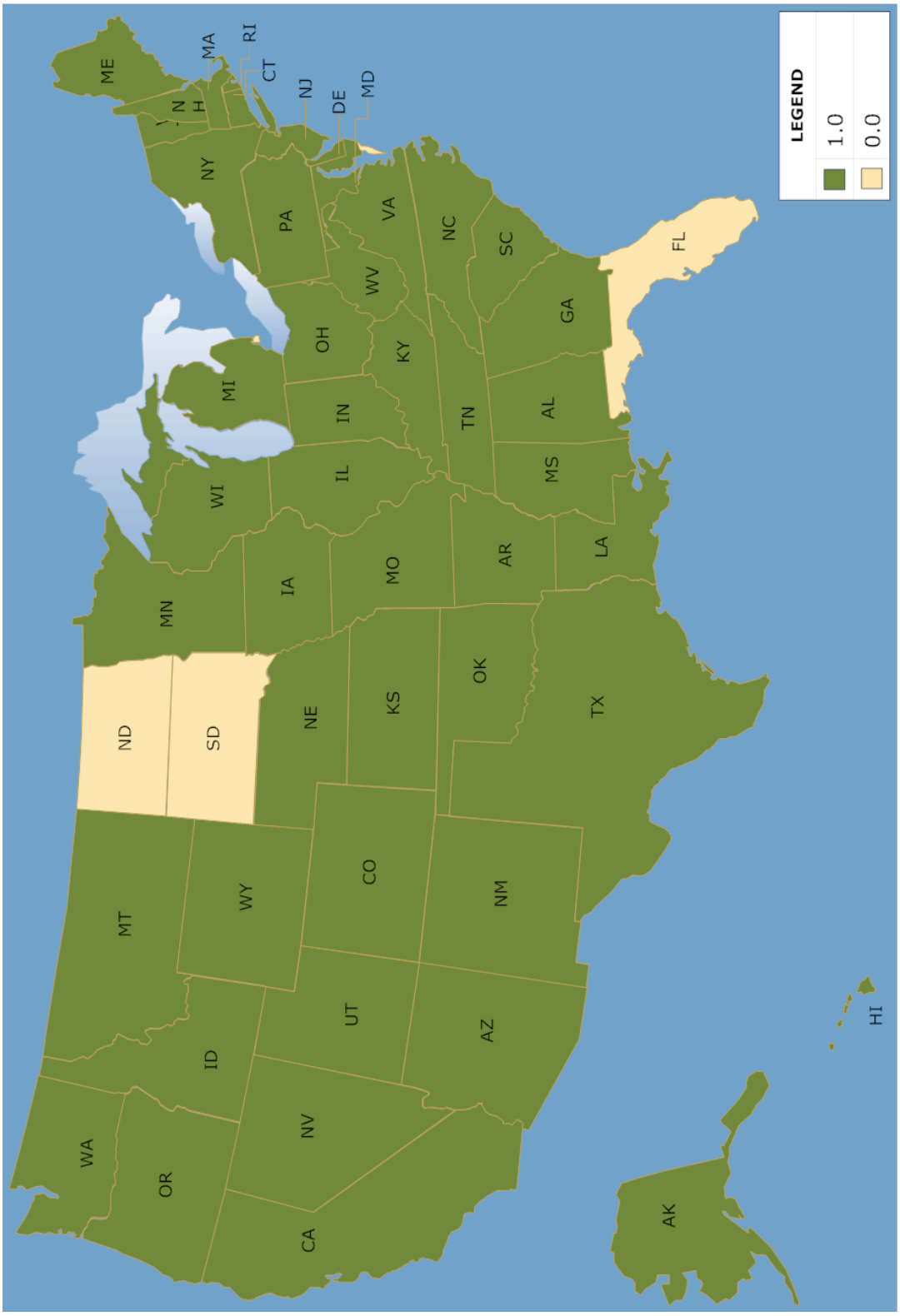

Figure 3.10. State translocation scores for 2007.

A change in states' translocations scores was not observed ($P = 0.17$) from 1997 to 2007 using the chi-square test (Table 3.1). Regions were found to be a determinant of variance for states' 1997 translocation scores ($F = 2.34$, $P = 0.04$) and population density was found to be a determinant of variance for states' 2007 translocation scores (F=10.16, P=0.00); none of the other 5 characteristics tested was found to be a determinant of variance in 1997 or 2007 using ANOVA (Table 3.2).

Euthanasia

States that required nuisance animals to be killed in a manner that conformed to the recommendations of the American Veterinary Medical Association (AVMA; Andrews et al. 1993, Beaver et al. 2001) received a score of 1.0. States that recommended or required nuisance animals to be killed in a "humane" manner, and either explained what killing methods they considered to be humane, or listed methods that were not included in the AVMA recommendations, received a score of 0.5, and states that did not address euthanasia at all received a score of 0.0.

The 1997 study assigned a score of 1.0 to 3 states (6%), a score of 0.5 to 15 states (29%), resulting in a mean score of 0.21, while in 2007, 20 states received a score of 1.0 and 13 received a score of 0.5, for a mean score of 0.39 (Figure 3.11, Figure 3.12, Table 3.1, Appendix C). A change in states' euthanasia scores was observed ($P = 0.00$) from 1997 to 2007 using the chi-square test (Table 3.1). None of the 5 characteristics tested was found to be a determinant of variance for states' euthanasia scores in either 1997 or 2007 using ANOVA (Table 3.2).

Humane Treatment Guidelines

States received a score of 1.0 for a requirement to comply with established handling, transportation, and care standards. A score of 0.5 was assigned to states that mentioned humane treatment without specific definition, required NWCOs to comply with humane standards established for wildlife rehabilitators, or required NWCOs to follow federal

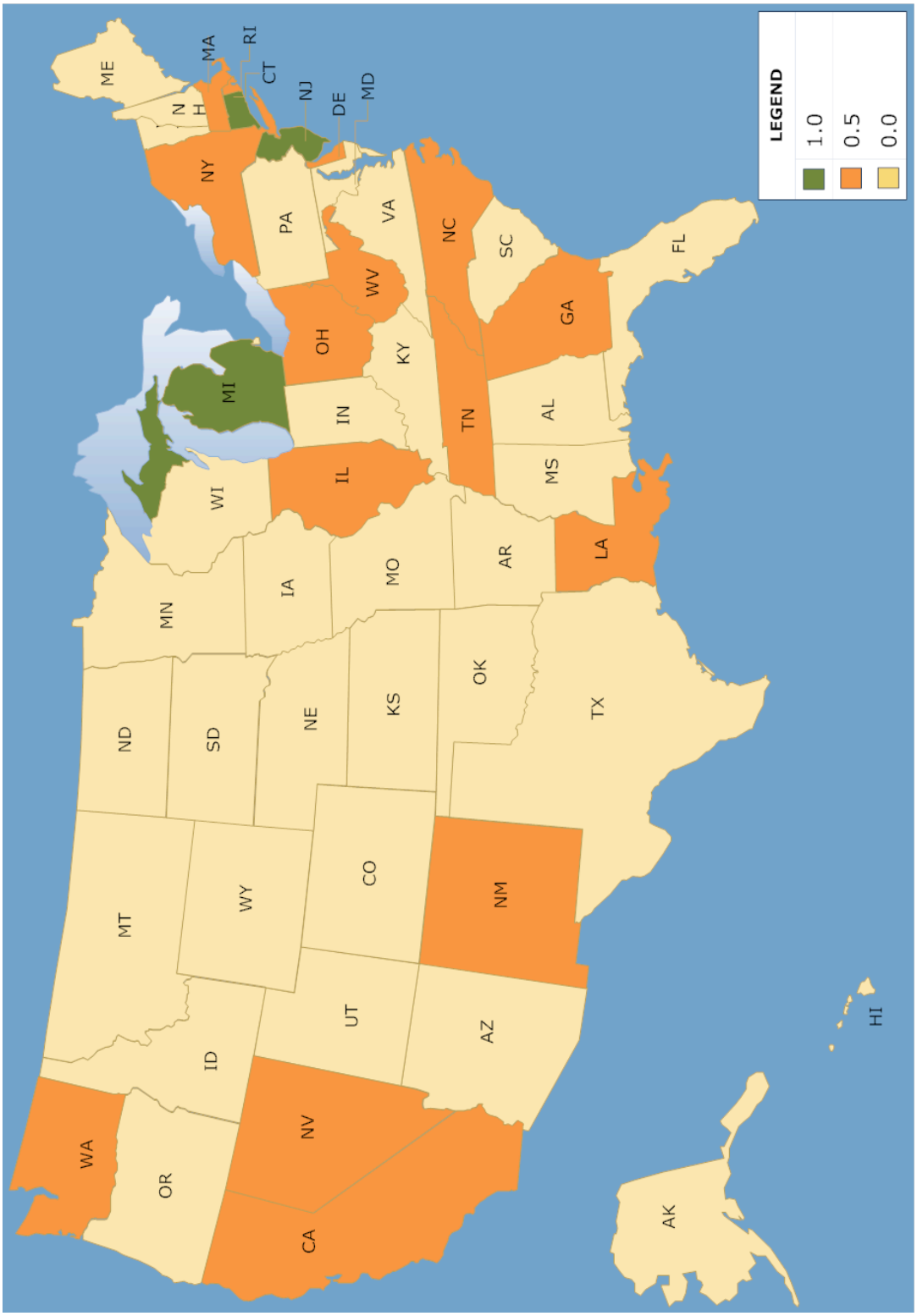

Figure 3.11. State euthanasia scores for 1997.

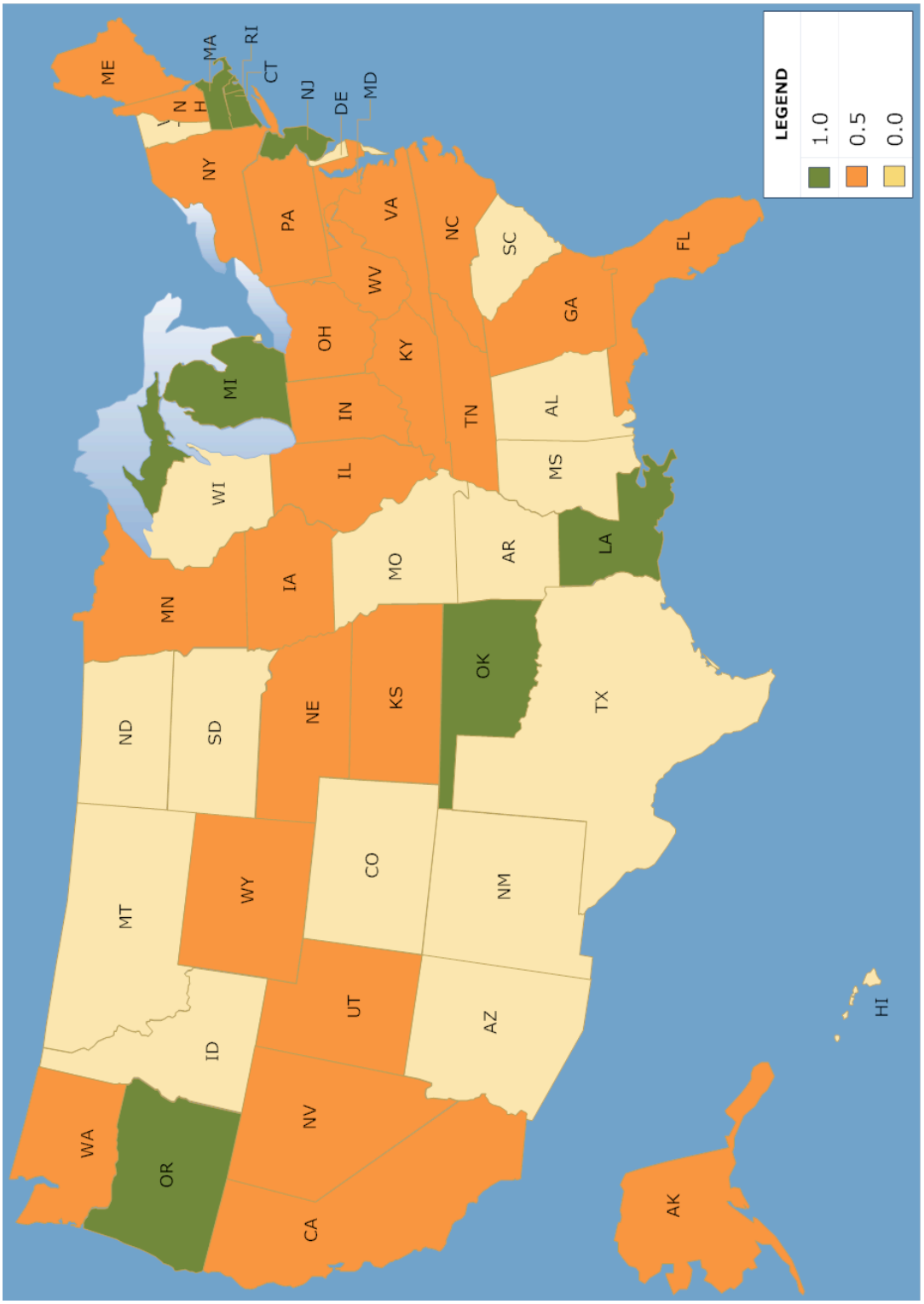

Figure 3.12. State euthanasia scores for 2007.

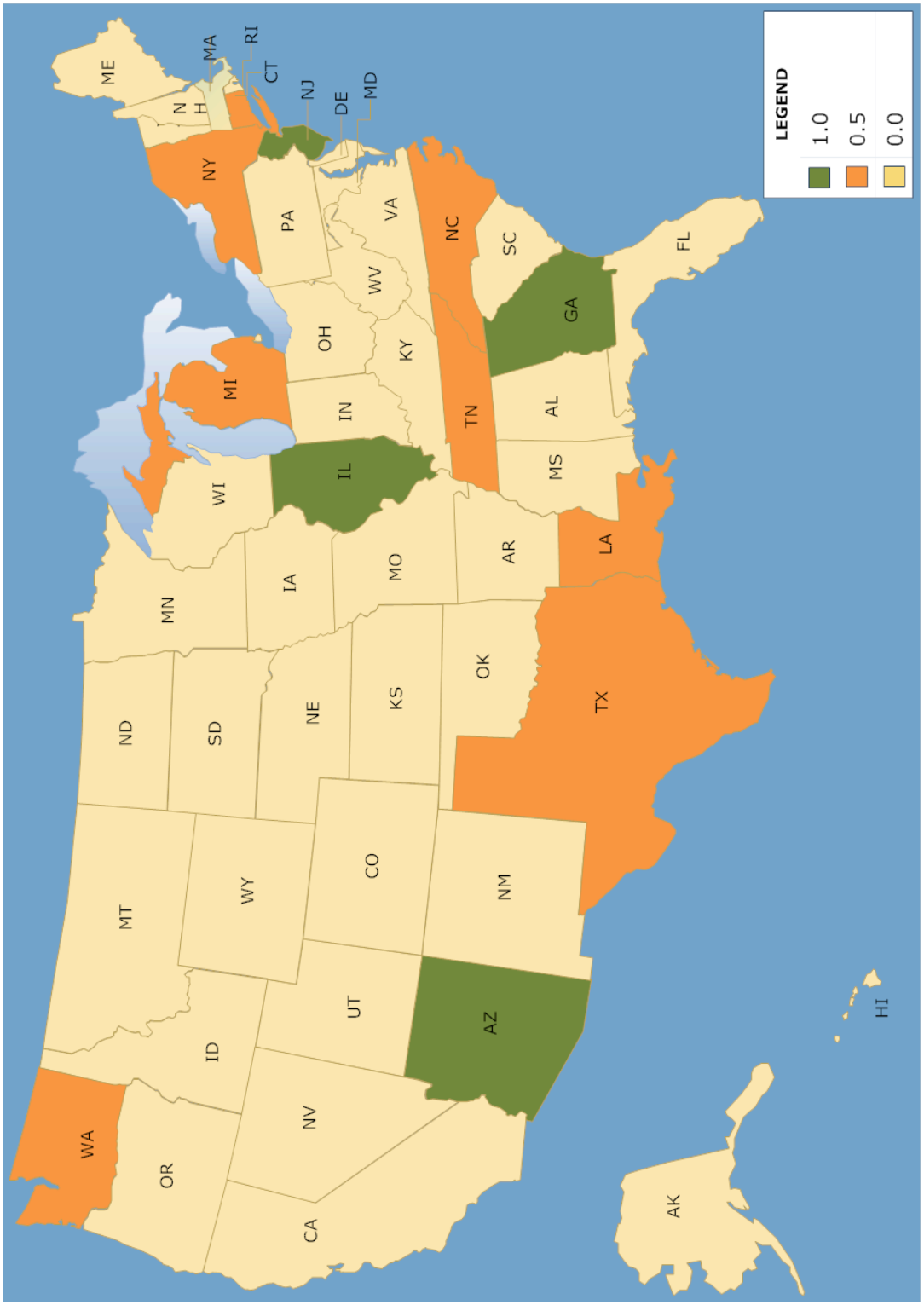

Figure 3.13. State humane treatment scores for 1997.

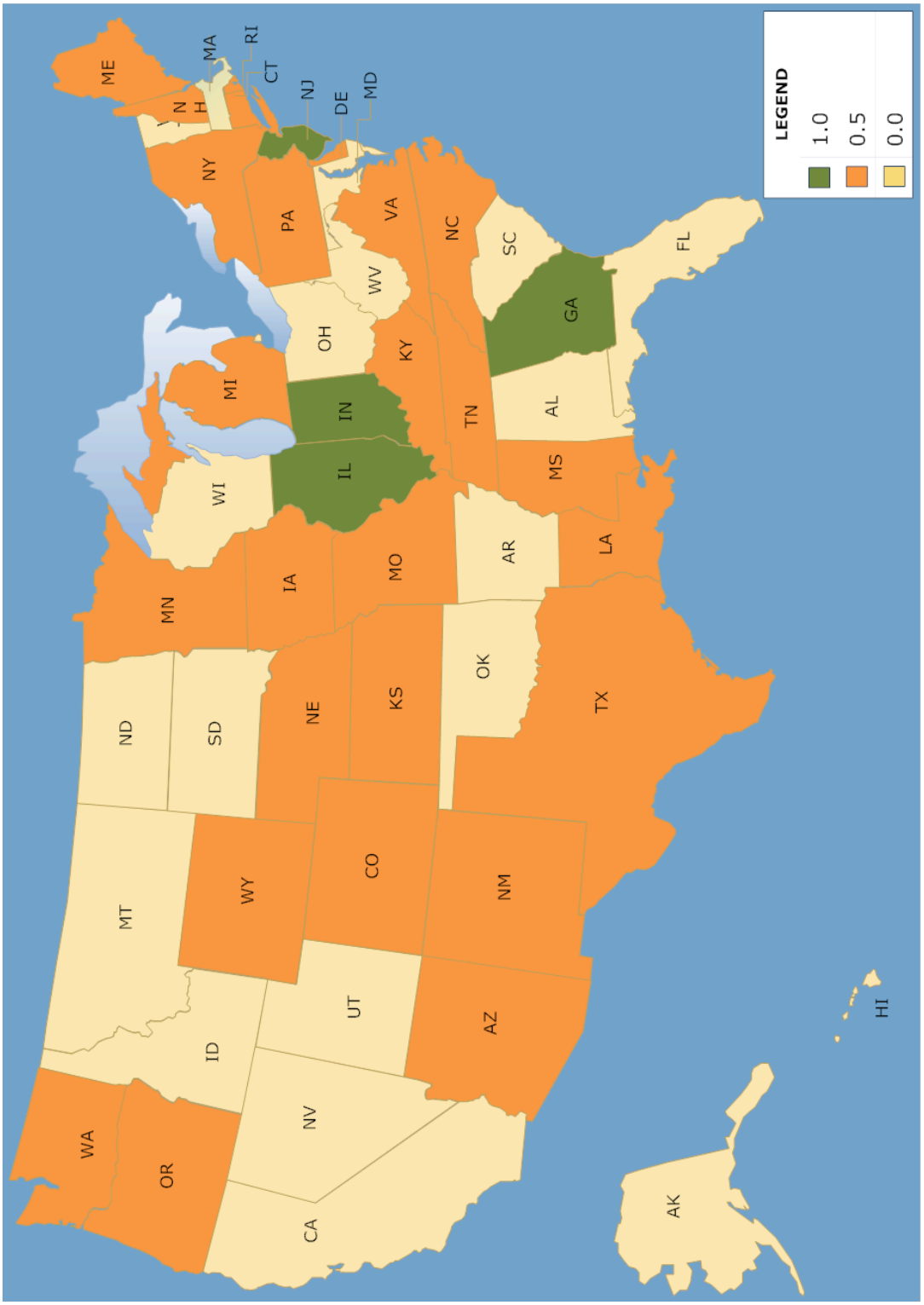

Figure 3.14. State humane treatment scores for 2007.

captivity standards for exhibit animals. A score of 0.0 was assigned if there was no mention of humane treatment.

In the 1997 study, 4 states (8%) received a score of 1.0 and 8 states received a score of 0.5 for a mean score of 0.16, and in 2007, 4 states received a score of 1.0, and another 25 states received a score of 0.5, for a mean score of 0.32 (Figure 3.13, Figure 3.14, Table 3.1, Appendix C). A change in states' humane guidelines scores was observed ($P = 0.00$) from 1997 to 2007 using the chi-square test (Table 3.1). None of the 5 characteristics tested was found to be a determinant of variance for states' humane guidelines scores in either 1997 or 2007 using ANOVA (Table 3.2).

Threshold of Damage

For the sake of this study, "threshold of damage" is a set of pre-determined circumstances or events that must be met before wildlife control methods may be legally implemented, such as a wild animal that poses an imminent threat to human health and safety or property. In such a case, a homeowner who can show that tree squirrels that are gnawing on the soffit of his home, for example, would meet the threshold of damage requirement; a homeowner who simply does not like to see squirrels in his yard would not.

States that required an established threshold of damage to be exceeded before a NWCO could take action received a score of 1.0, those that had some kind of threshold of damage recommendation received a score of 0.5, and states that did not address the issue received a score of 0.0.

In 1997, 1 state received a score of 1.0 and 10 states had a score of 0.5, for a mean score of 0.12, and in 2007, 10 states received a score of 1.0 and 16 states received a score of 0.5, for a mean score of 0.35 (Figure 3.15, Figure 3.16, Table 3.1, Appendix C). A change in states' threshold of damage scores was not observed ($P = 0.29$) from 1997 to 2007 using the chi-square test (Table 3.1). Urban population frequency was found to be a determinant of variance for states' 1997 threshold of damage scores ($F = 2.16$, $P =$

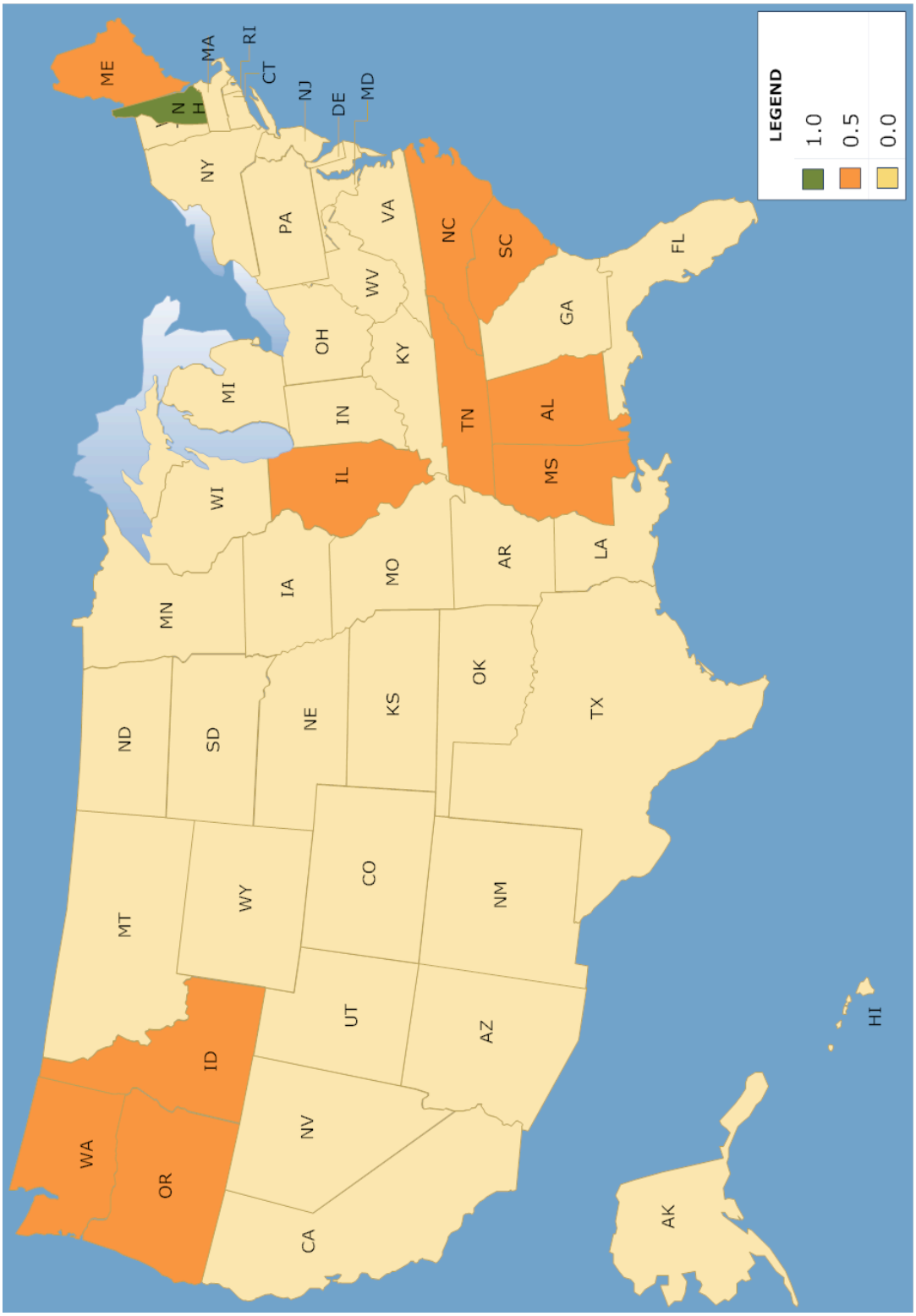

Figure 3.15. State threshold of damage scores for 1997.

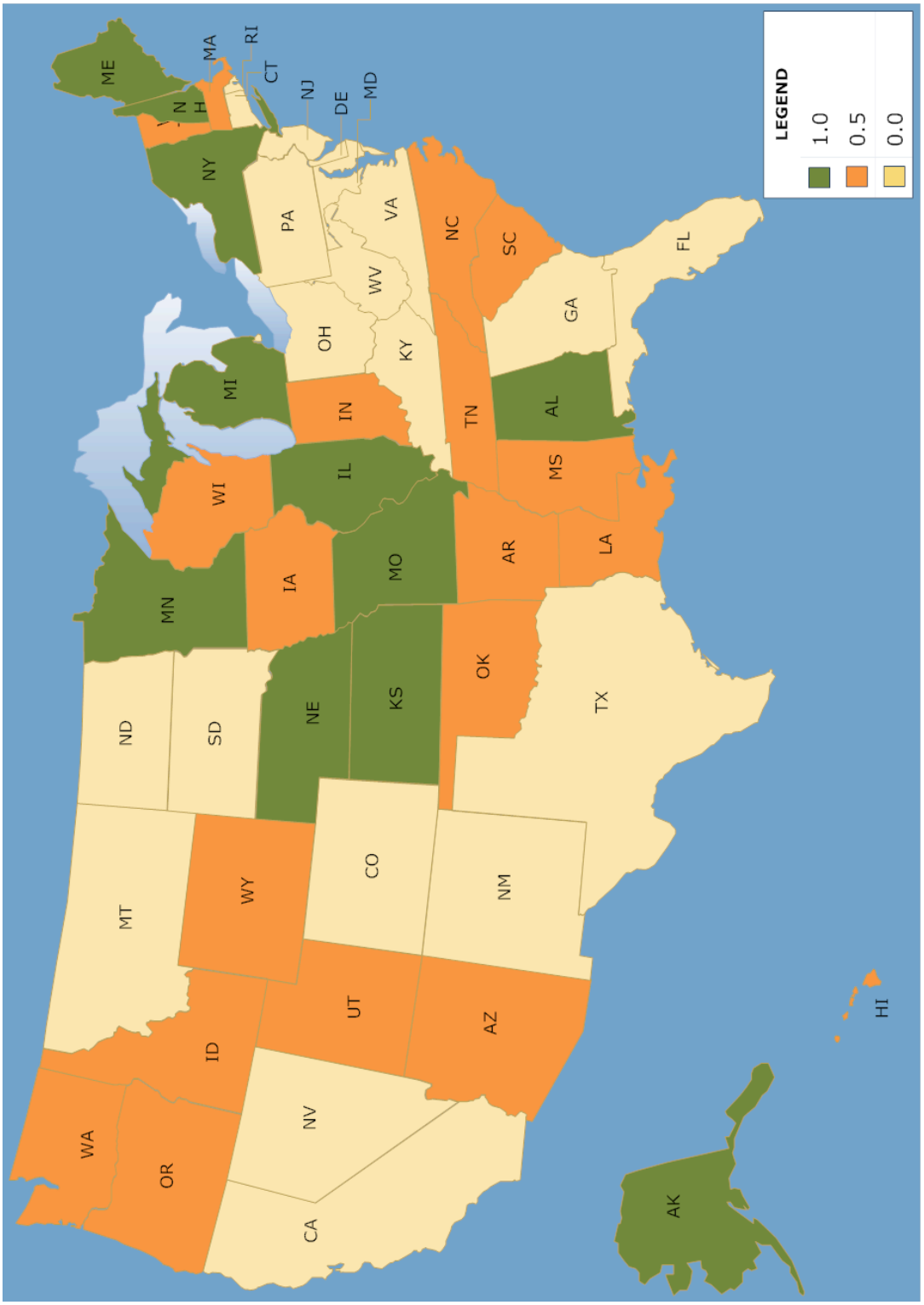

Figure 3.16. State threshold of damage scores for 2007.

0.05); none of the other 5 characteristics tested was found to be a determinant of variance in 1997 or 2007 using ANOVA (Table 3.2).

Consumer Protection

Hadidian et al. (2001) identified consumer protection as "any requirement that homeowners be presented with information to help them make an informed decision about management options" as well as requirements such as liability insurance. States that addressed consumer education and protection through regulations, policy statements, or directives received a score of 1.0; those states that did not address the issue received a score of 0.0.

In 1997, 6 states (12%) received a score of 1.0 for a mean score of 0.12, compared to 12 (24%) in 2007 for a mean score of 0.24 (Figure 3.17, Figure 3.18, Table 3.1, Appendix C). A change in states' consumer protection scores was observed ($P = 0.00$) from 1997 to 2007 using the chi-square test (Table 3.1). The number of MSAs was found to be a determinant of variance for states' 2007 consumer protection scores ($F = 3.31$, $P = 0.00$); none of the other 5 characteristics tested was found to be a determinant of variance in 1997 or 2007 using ANOVA (Table 3.2).

Integrated Pest Management

States that required or recommended IPM approaches and strategies received a score of 1.0, while states that included discussion of a hierarchical approach in their directives, suggestions, or policy statements received a score of 0.5.

In 1997, 3 states (6%) received a score of 1.0 and 8 states (16%) received a score of 0.5 for a mean score of 0.14; the number of states that received a score of 1.0 did not change in 2007, but the number of states with a score of 0.5 rose to 15 (29%), and the mean score rose to 0.21 (Figure 3.19, Figure 3.20, Table 3.1, Appendix C). A change in states' IPM requirement scores was observed ($P = 0.05$) from 1997 to 2007 using the chi-square test (Table 3.1). None of the 5 characteristics tested was found to be a

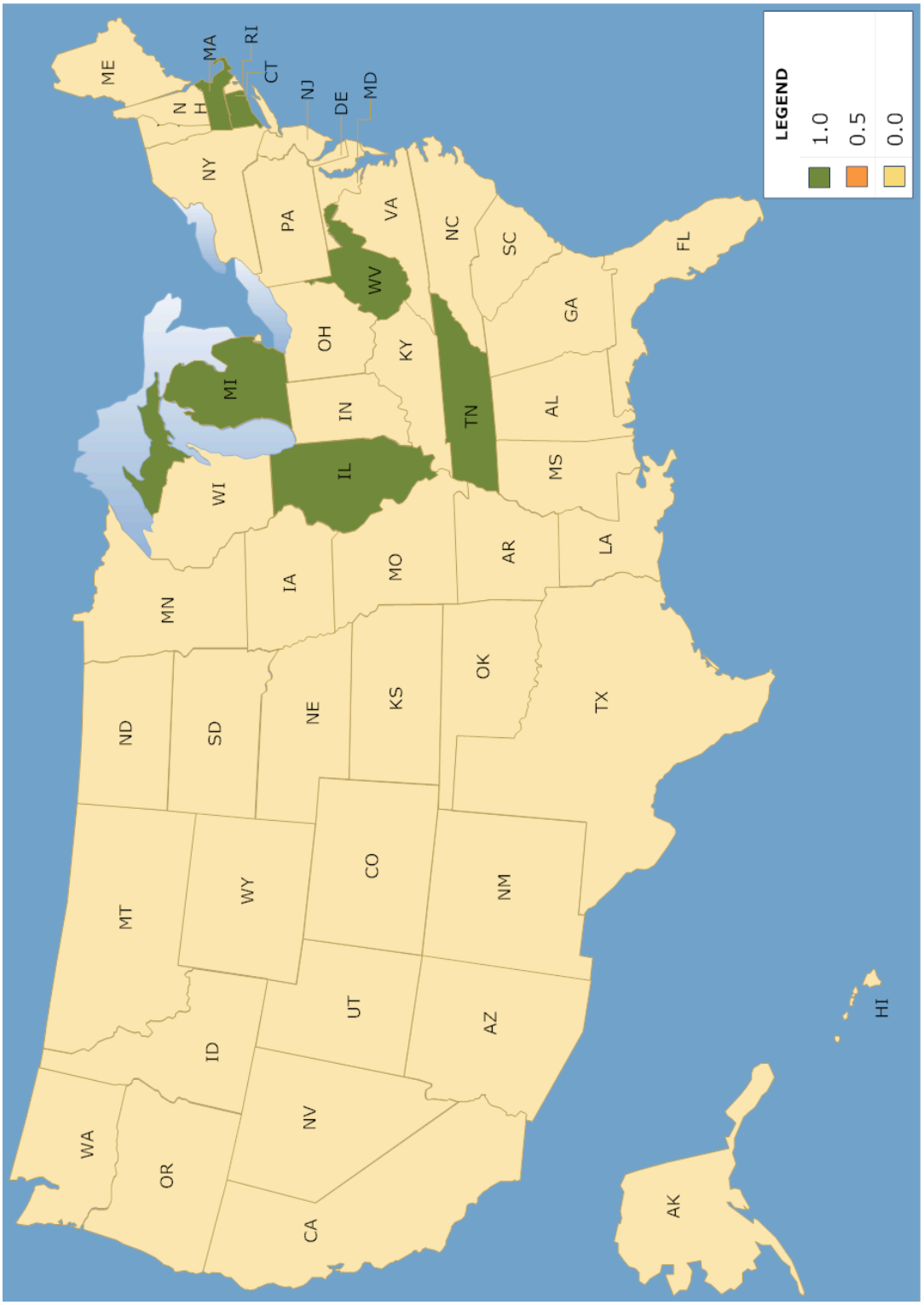

Figure 3.17. State consumer protection scores for 1997.

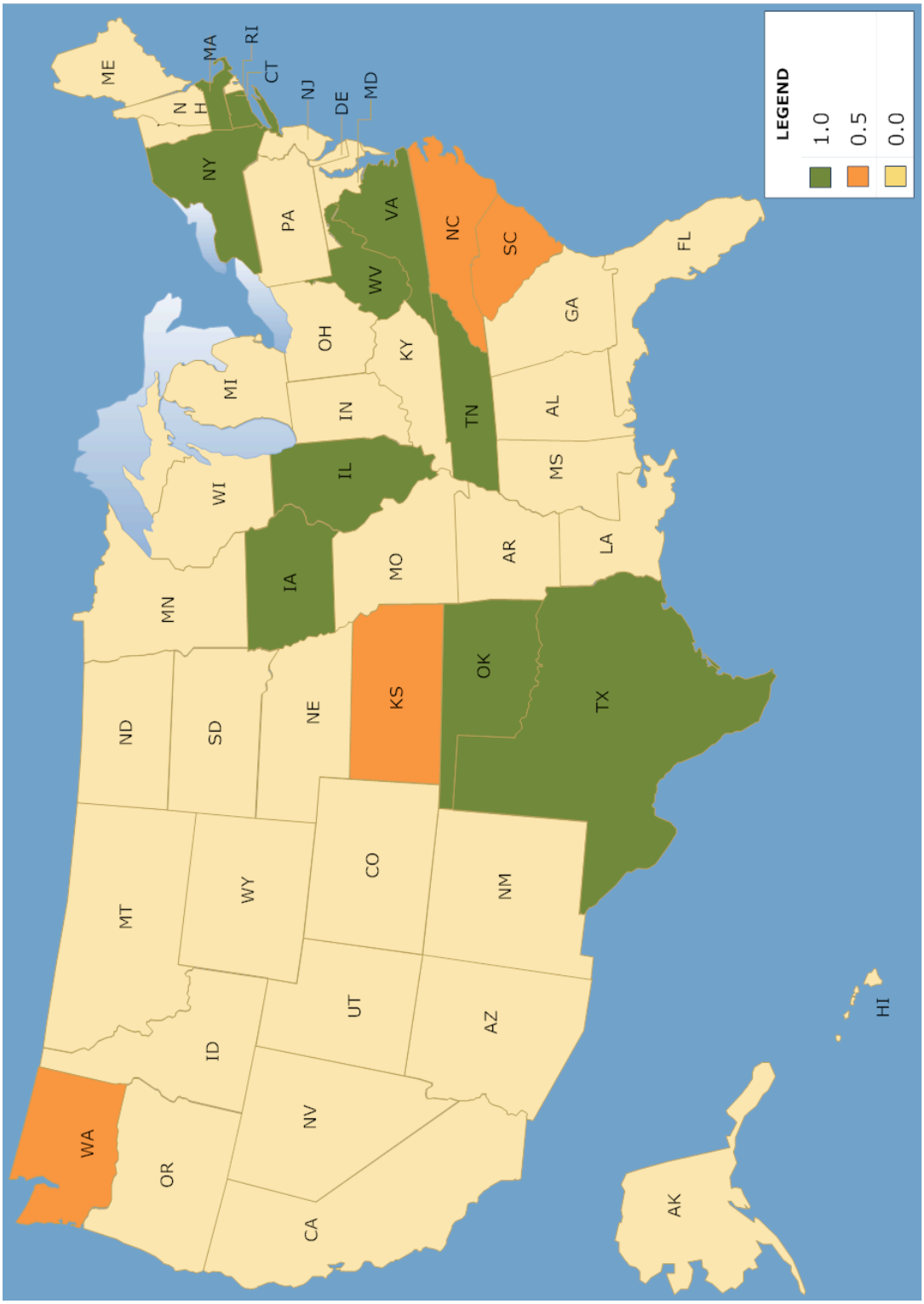

Figure 3.18. State consumer protection scores for 2007.

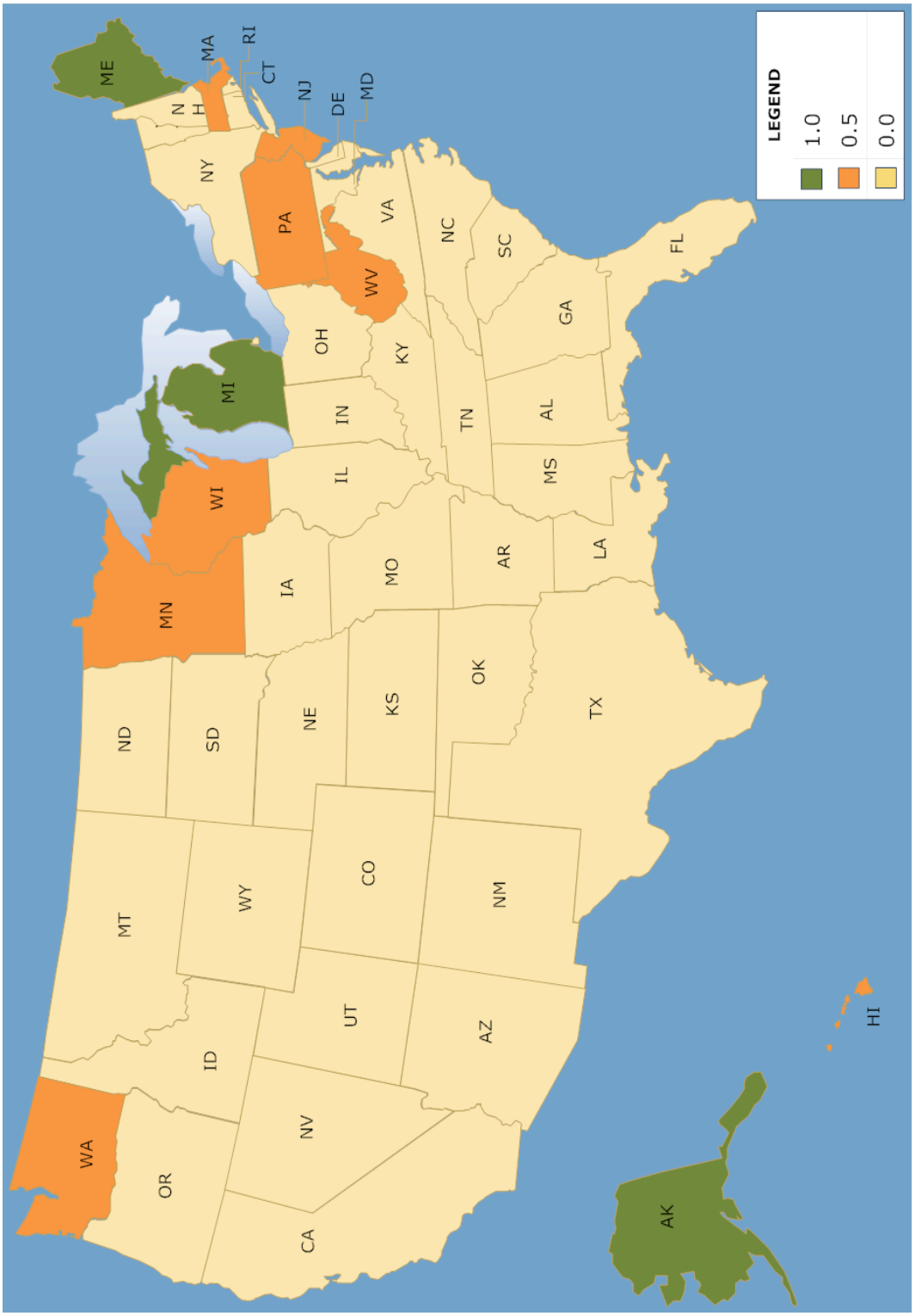

Figure 3.19. State IPM scores for 1997.

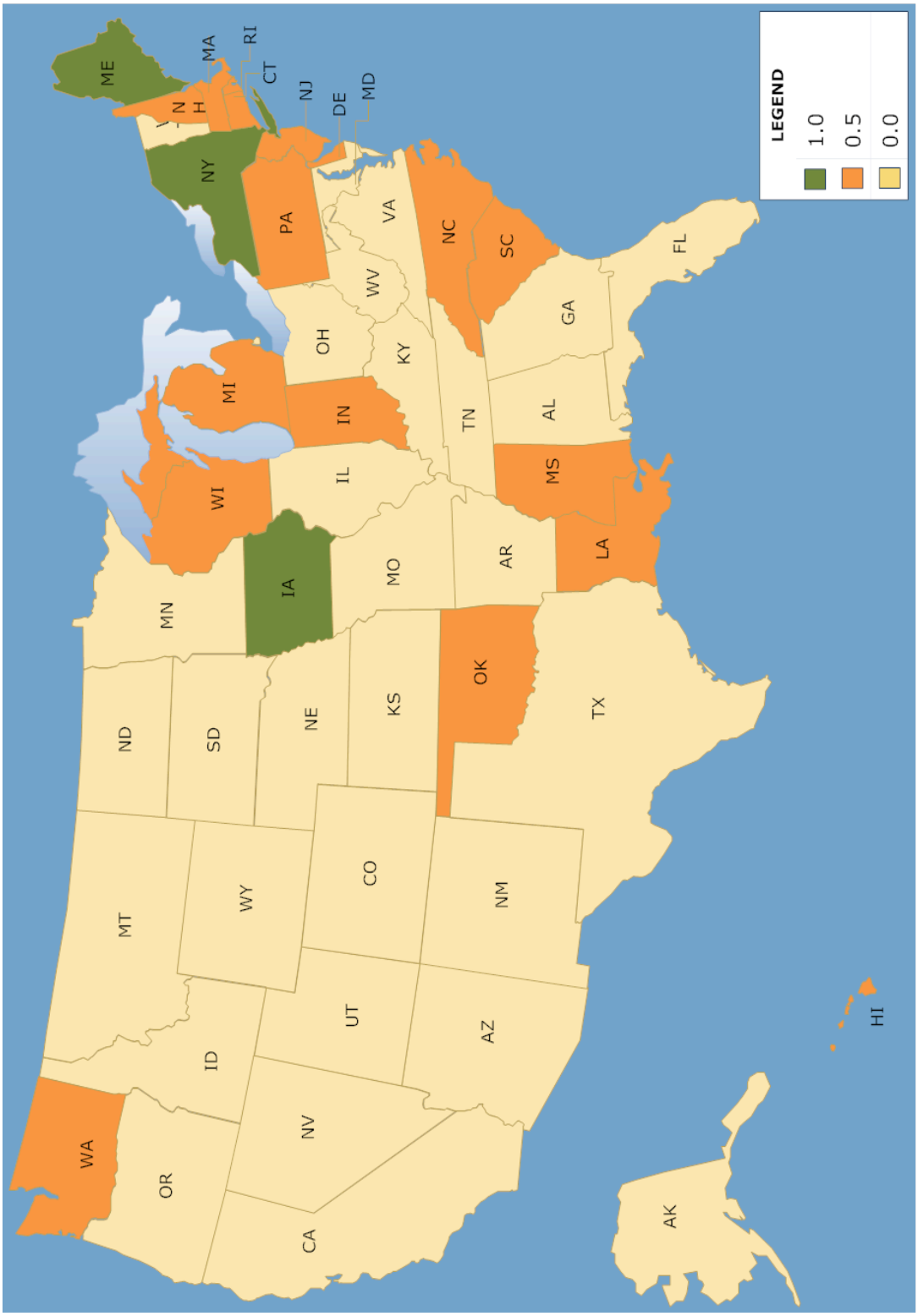

Figure 3.20. State IPM scores for 2007.

determinant of variance for states' IPM requirement scores in either 1997 or 2007 using ANOVA (Table 3.2).

Cumulative Scores

Seven states received a cumulative score of 7.0 or higher in 2007 (Connecticut, Illinois, Indiana, Iowa, Maine, New York, North Carolina); the highest cumulative score assigned in 1997 was 6.5 (Connecticut, Illinois, Massachusetts, Michigan, North Carolina, and West Virginia). Twelve states and the District of Columbia did not regulate NWCOs at all in 1997, compared to only 2 states and the District of Columbia in 2007. The mean cumulative score in 1997 was 2.20 (Figure 3.21, Table 3.1, Appendix C) out of a possible 10, compared to a mean cumulative score of 4.28 in 2007 (Figure 3.22, Table 3.1, Appendix C).

A change in states' cumulative scores was not observed ($P = 0.12$) from 1997 to 2007 using the chi-square test (Table 3.1). Regions were found to be a determinant of variance for states' 1997 cumulative scores ($F = 2.28$, $P = 0.04$); none of the other 5 characteristics tested was found to be a determinant of variance in 1997 or 2007 using ANOVA (Table 3.2).

Discussion

Based on the chi-square test, the null hypothesis posed for Phase II of this study was rejected ($P = 0.00$). None of the 5 characteristics tested proved to be a consistent determinant of variance, either for a single scoring category or for cumulative scores.

It is possible that ≥ 1 of the 5 characteristics tested could have been a driving force within an individual state, but this could not be determined using the methods employed for this study. States' political climates (e.g., "red" versus "blue"), public and/or private land frequencies, dominant attitudes regarding valuation of wildlife (e.g., utilitarian versus moralistic), or wildlife management agency budgets are all possible determinants of variance that were not tested during this study but may warrant future investigation.

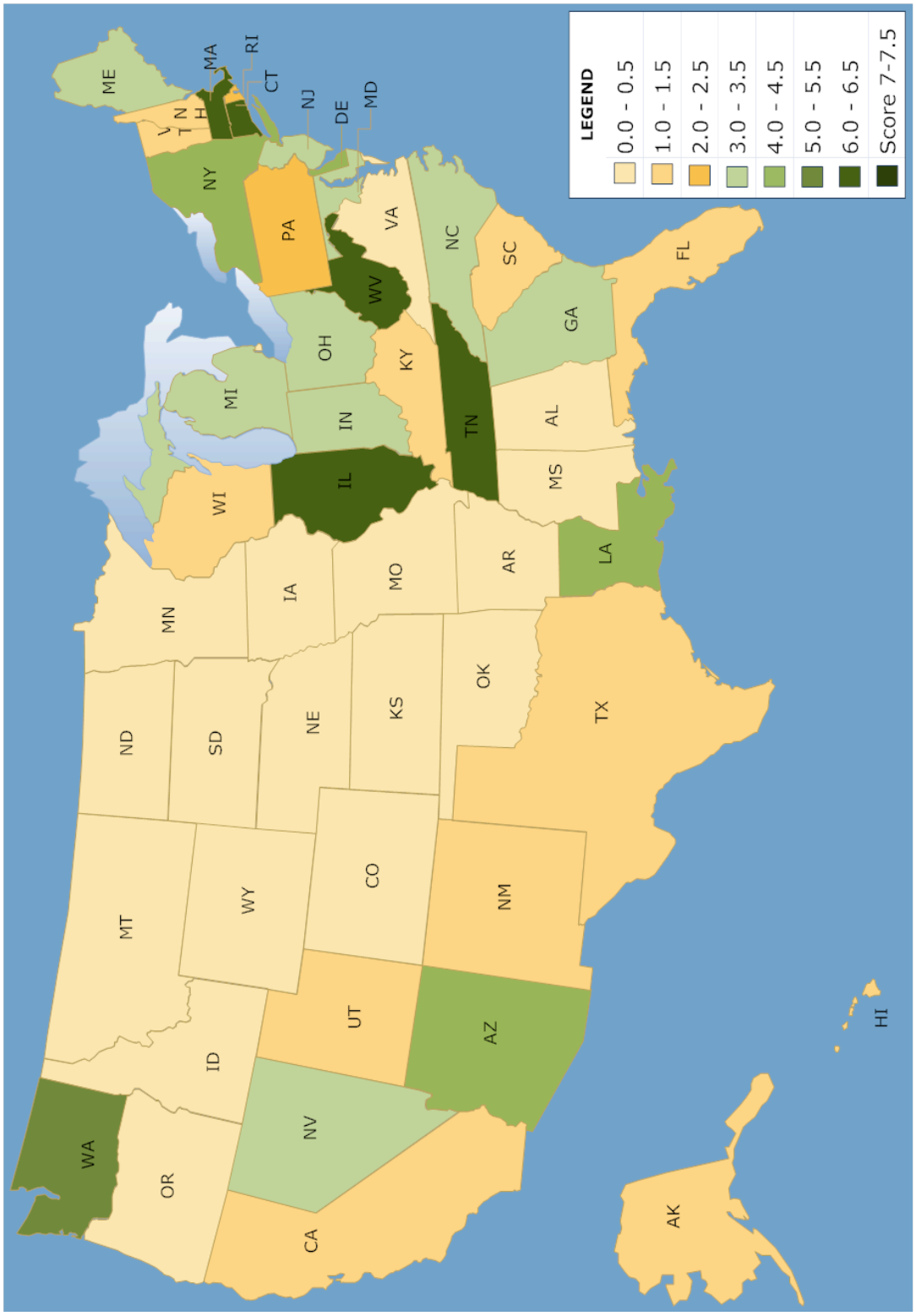

Figure 3.21. State cumulative scores for 1997.

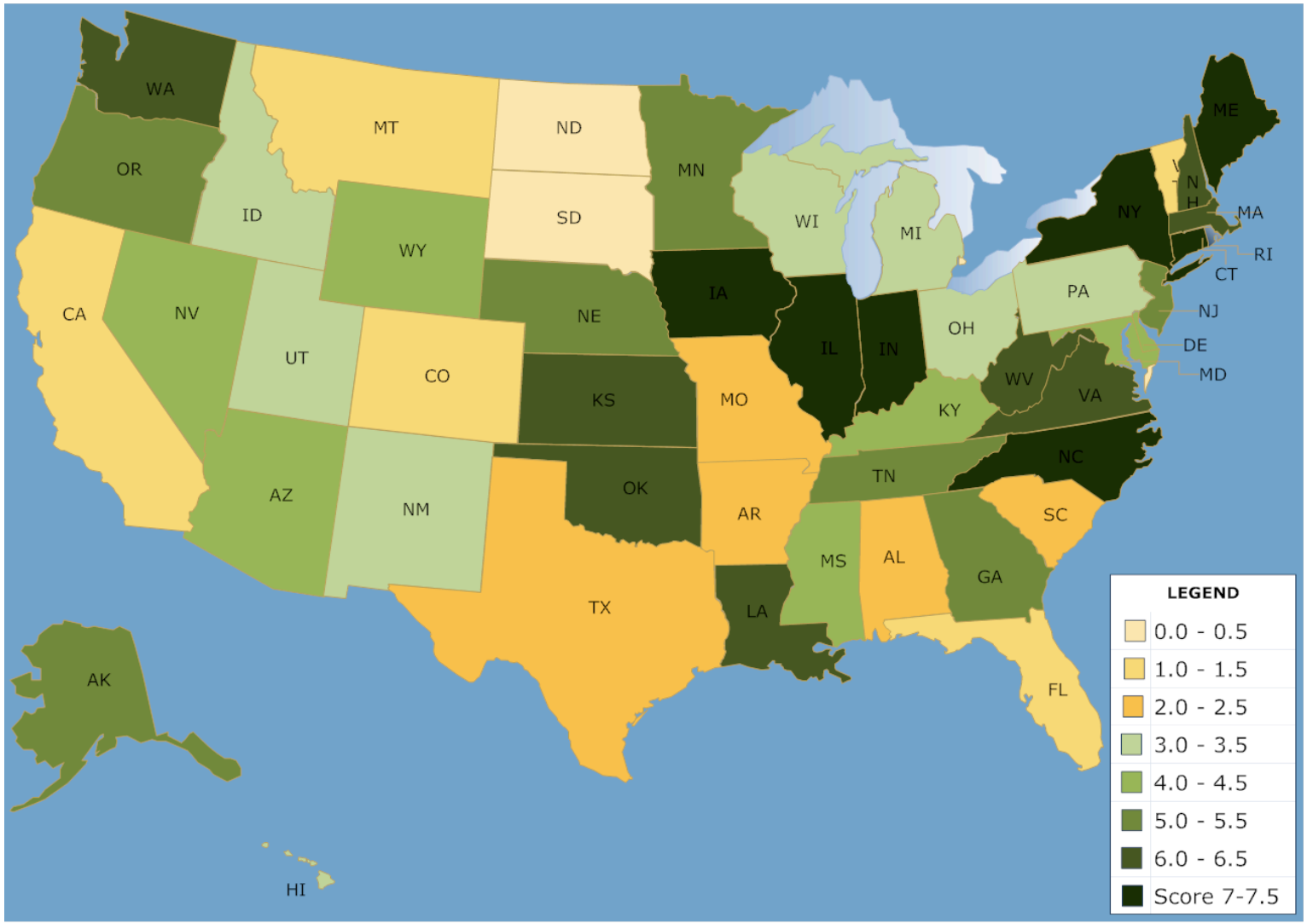

Figure 3.22. State cumulative scores for 2007.

One possible explanation for the lack of determinants of variance at the national level may be the issue's current position within the public policy life cycle (Figure 3.23), between the recognition and the formulation stages. The recognition stage begins with the early perception that a problem exists. The issue has low political weight, but it is beginning to attract attention from the media and at some level of government. The formulation stage is marked by rapidly increasing political weight with increased awareness by the public, the media, and the government. Policymakers begin to examine the issue and develop ways to address the problem. As a policy moves from the formulation to implementation stage it begins to lose political weight again; decisions have been made and the focal point moves to regulatory agencies.

Many states that received low scores in 1997 have since developed new regulations and policies for overseeing NWCO activities; others are only now beginning to recognize the issue as one that needs attention. Although there were only 2 states and the District of Columbia without any regulation or oversight of NWCOs in 2007, the mean cumulative score of 4.28 out of 10 suggests that NWCO regulation is still in the early stages of the public policy life cycle. Therefore, it is unlikely one would see many characteristics that predict the NWCO regulatory environment at the national level.

A survey of state agencies in 1997 found that 95% of respondents believed their agency should provide administrative oversight of the NWC industry (Barnes 1998), but there are political, social, and economic challenges associated with managing NWC activities. Several agencies commented in the Barnes (1998) study that they did not have the budgetary or personnel resources to implement a NWCO oversight program. Other states indicated they no longer had statutory authority to regulate nuisance wildlife, except in the case of big game and migratory birds. Several respondents suggested regulatory oversight should be the responsibility of the structural pest control industry. One or more of these factors could continue to play a role in whether and/or how states address the issue of regulating the NWC industry.

Barnes (1998) found that several state agencies were strongly opposed to providing administrative oversight of the NWC industry. One state responded that nuisance

wildlife control is not a resource problem because "these species are abundant and are not in immediate need of protection." One wonders how wildlife professionals could be certain of the lack of NWC activities' impact on species of interest when only 42% of states required any kind of reporting at the time of the survey. Questions remain in 2007, with 76% of states requiring some kind of annual report, about whether agencies are using the data within these reports to assess the potential impact on wild populations. In spite of the challenges and ambivalence expressed by some of the 1997 responded, the overall trend during the past decade has been toward increased regulatory oversight.

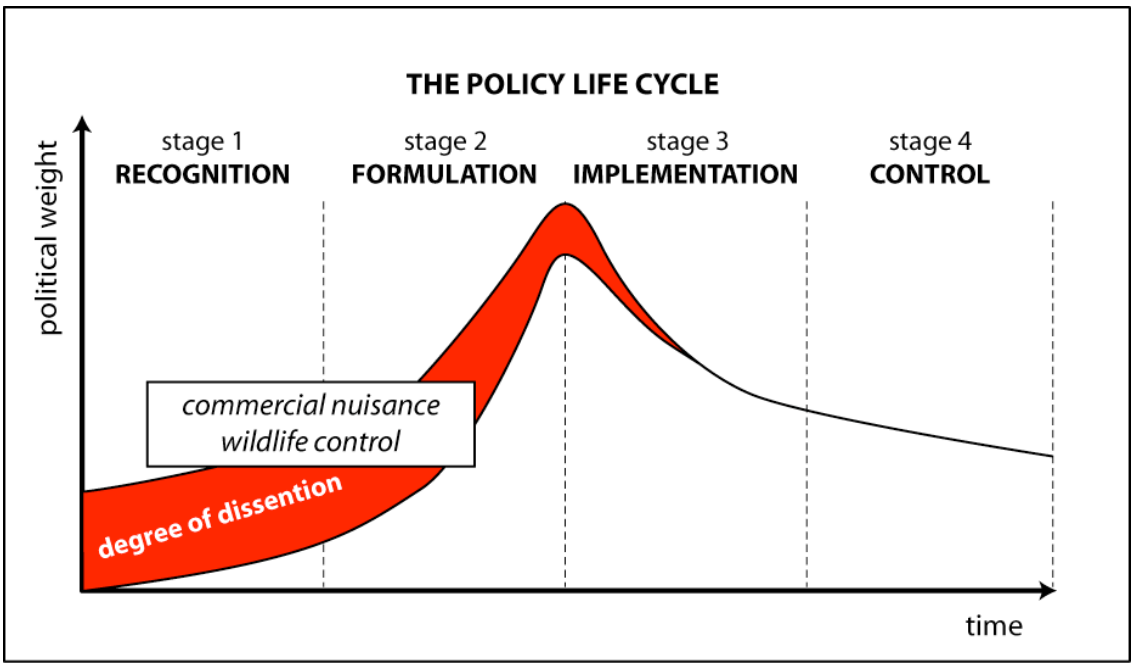

Figure 3.23. Current position of the NWC industry in the public policy life cycle (Wright and Nebel 2002).

Respondents to the Barnes (1998) survey expressed concerns over the practice of translocation. Seventeen percent (17%) of survey respondents indicated they had implemented translocation restrictions on certain species, with a heavy emphasis on limiting translocation of RVS. All respondents reported that disease concerns were the

primary reason they did not allow translocation of nuisance wildlife, with impact of translocated animals on populations at the release site listed as a secondary concern (45%). This suggested that state agencies were tightening policies regarding translocation of nuisance wildlife, and the change in states' scores for translocation from 1997 to 2007 appears to confirm that prediction; 49% of states addressed the issue of translocation in 1997, compared to 90% in 2007.

The emphasis of most agencies in 1997 seemed to be on the impact of translocation at the release site. Wildlife professionals have cited transmission of diseases and parasites as a potential negative effect of translocation, along with the threat of introducing maladaptive genetic and behavioral complexes into recipient populations (Craven et al. 1998). The potential impact of at the trap site is another potential concern, but this issue has received even less research attention than translocation. One must keep in mind the basic ecological concept that whenever an individual animal is removed from its territory, regardless of whether the method used is cage-traps and translocation or lethal means, it creates a vacuum that will be filled by some other individual. One need only look at the number of NWC businesses in the U.S. and the conservative estimate of demand for services to realize that removal of wild animals is happening on a large scale. The fact that a state disallows translocation of problem wildlife, for all species or a select few, may fail to achieve the desired management objectives as long as animals may be removed using lethal means. Animal welfare organizations such as the Humane Society of the United States (Hadidian et al. 2002) have raised ethical concerns about the impact of wildlife control practices on individual animals, and have advocated cage-trapping combined with exclusion and on-site release. The establishment of this methodology as a "best practice" would likely be beneficial at the population level as well, by decreasing movement and its associated negative outcomes within the resident population.

Finally, regulation of NWCO activity is only half of the oversight equation; enforcement is equally important. Statutes and regulations enacted without effective enforcement mechanisms carry an implicit assumption that voluntary compliance will

occur, but it is generally accepted that without enforcement there will be little to no compliance (Rowcliffe et al. 2004). Budgetary constraints are an ongoing challenge for most DNRs, and regulation of NWCO activities is time consuming and expensive (Barnes 1998). Even if the model proposed by Barnes (1997) for regulating NWCOs was enacted across the United States, mechanisms for funding law enforcement efforts must be put into place before regulations can create the desired outcomes.

Chapter IV will address management implications and recommendations based on the results from Phases I and II of this study, along with suggestions for future research.

CHAPTER IV

SUMMARY

Cities and subdivisions may not be the first places that come to mind when one hears the word "habitat," but human-dominated landscapes are just that for species that are well suited to the conditions found in these locations or can adapt. Food and water sources are plentiful, shelter is available, and the dominate predator is the automobile. Under such conditions, wildlife populations may expand beyond anything encountered in "natural" habitats (Manski et al. 1981).

As a result, a great many human-wildlife conflicts occur in the U.S. each year, and the number will likely to continue to grow for the foreseeable future. Human encroachment into undeveloped wild lands, the presence of adaptive wildlife species that can tolerate or even exploit human environments, and the growing lack of knowledge and awareness of the natural world with each new generation of urban dwellers (Acord et al. 1994, Organ and Ellingwood 2000, Louv 2005) all contribute to the problems related to living with wildlife. Human tolerance of wildlife is highly variable and often situational in nature. People living in metropolitan areas have been conditioned to expect support services for everything from garbage removal to domestic animal control. As a result, when conflicts between humans and wildlife arise, urban dwellers expect assistance from some level of government (Lindsey and Adams, 2006). Natural resource management agencies were never designed or funded to handle the demand for assistance from urban and suburban residents, however, and the private sector has stepped in to address this unmet need for services.

Twenty-five years ago, the NWC industry, such as it was, consisted primary of individuals who used recreational trapping skills and word-of-mouth marketing to make a little extra money. In some parts of the country, particularly in the less populated states, this description is still valid to some degree. But the number of human-wildlife conflicts handled each year, the growing number of NWC businesses, and the annual

sales revenue generated by these activities suggest that NWCOs already play a key role in addressing wildlife damage issues across the U.S. As the country continues to urbanize, public demand for NWC services will become even more common, amplifying the potential impact on both wildlife and human populations, and creating challenges for wildlife professionals, agency administrators, and policy makers.

Management Recommendations

Commercial NWC activity in the U.S. can no longer be viewed as something that occurs on a small scale. This study has conservatively estimated that NWC businesses alone—not counting individuals who operate without a formal business name—are handling >473,000 human-wildlife conflict complaints annually. Two management recommendations resulting from this study are described below: 1) increase regulatory oversight; and 2) standardize regulatory oversight.

Increase Regulatory Oversight

Bluett et al. (2003) concluded at the end of their review of the NWC regulatory environment in Illinois that the state agency's role in providing oversight is warranted by the ecological, ethical, and practical consequences of capturing and killing or translocating large numbers of wild animals. Based on that analysis, the current national level of activity surely justifies increased regulatory oversight.

Regulation of commercial NWCOs has increased somewhat over the past decade, but the amount and type of oversight varies greatly from state to state. In the 37 states where some kind of license, permit, or registration were needed to legally operate a NWC business, licensees may be required to undergo specialized training and/or pass a qualifying exam, or they may be required to do little more than fill out a rudimentary application. In either case, once they are in possession of the license they are allowed to remove animals from established territories at their own discretion, either by lethal means or using trap and translocate methods. NWCOs provide a service, but they are also privatizing management of a public resource and making a profit doing so.

Therefore, it seems reasonable to expect all commercial NWCOs, regardless of where they live, to be subjected to some level of oversight by a public-sector agency, and to demonstrate an understanding of control techniques, IPM strategies, euthanasia and humane handling methods, and common zoonotic diseases, as well as basic ecological principals and the potential effects of their control decisions, prior to being allowed to engage in these commercial activities.

Standardize Regulatory Oversight

The variation in regulation and professional standards can be challenging for NWCOs, many of whom offer their services in >1 state. Differences in reporting requirements alone are challenging and potentially costly for business owners. As a result, some within the industry have raised the possibility of national guidelines. The Humane Society of the United States (HSUS) developed a draft of standards it hopes to see enacted through various state legislative bodies. In response, NWCOA developed their own draft standards in an attempt to give the private sector greater influence on pending legislation and wildlife regulations (Clark 2003). State wildlife agencies should be encouraged to work closely with both the NWC industry and animal welfare community to develop and implement minimum national standards for NWCO oversight.

Future Research Needs

Relatively few reviews of NWC oversight have occurred, but the general findings of this and other studies suggest the need for greater attention on this increasingly important aspect of wildlife management. As outlined in Hadidian et al. (2001), 3 reviews of state NWC regulations, rules, and policies have occurred, and each identified a need to address statutory, administrative, and educational factors. Barnes (1997) proposed a model for licensing comprised of 3 elements: education, continuing education, and consumer protection. Schmidt (1998) suggested critical components of a continuing education program, emphasizing training in wildlife ecology and identification, state and federal wildlife and pesticide laws, parasites and diseases of concern to wildlife and

humans, chemical immobilization and euthanasia, and current and emerging technologies in wildlife damage management.

Hadidian et al. (2001) called for additional studies to "determine with greater precision the extent and volume of nuisance-wildlife control activities." This study has attempted to address the first half of that request, but additional research into the scope, characteristics, and regulatory oversight of the NWC industry is greatly needed. In states where regulation of NWCOs has been established, studies are needed to determine the extent and effectiveness of enforcement efforts. What happens if a NWCO does not submit a required annual report? What action is taken if an operator is found to be translocating animals in violation of established rules, or fails to follow euthanasia guidelines? Do agencies investigate businesses that advertise NWC services to ensure that their employees possess a license, if required? Has the agency ever denied a license or renewal application, and if so, for what reasons?

The methods used to collect data on NWC activity reports needs to be investigated, along with the types of data compiled. What do agencies do with the information found in annual reports? Is there any kind of periodic review of the NWC activities reported? Is the information entered into a database of some kind, or simply filed and/or archived? If a zoonotic disease outbreak were to occur in the human population, would agencies be able to quickly access annual report data to investigate possible links to NWC activity? In states where removal (lethal or by cage-trap) occurs (legally or illegally) the potential for zoonotic disease outbreaks, and related human health implications, should be give serious consideration.

Barnes (1993) and Hadidian et al. (2001) both called for research on the impact of NWC activities on urban wildlife populations, including survival, movements, habitat selection, and disease transmission by relocated animals. This remains an area in need of attention. Some publications have addressed translocation issues (e.g. Rupprecht and Smith 1994, Cunningham 1996, Mosillo et al. 1999), but more research is needed. Wildlife professionals also need to know the effects on trap site populations when individual members are removed, lethally or by cage-trap and translocation. What

happens when an animal is trapped and released on site, or is excluded from a den site within a human-built structure? Does the animal (and the conflict) simply move next-door? Without more information it is exceedingly difficult to develop effective management strategies.

Conclusion

The primary motivations behind this study were a desire to better understand an industry that is privatizing at least one aspect of wildlife management, and to contribute to the wildlife profession's understanding of wildlife damage management as it is currently practiced.

This study has provided conservative estimates of the number of NWC businesses, the industry's historic growth rate, and the annual sales revenue generated. Wildlife professionals, administrators, and policy makers can use this information when striving to meet their own natural resource management responsibilities, and when making decisions about how to provide adequate oversight of activities and encourage greater professionalism. Additionally, this study has offered a detailed description of the current NWC regulatory environment, its management implications, future research needs, and recommendations for moving forward.

The late 1990s saw a flurry of research activity focused on regulatory oversight and various characteristics of the NWC industry, but the number of publications has decreased in recent years. This study has been, in part, an attempt to increase the profile of this issue and, hopefully, stimulate further investigation.

LITERATURE CITED

Acord, B. R., C. A. Ramey, and R. W. Werge. 1994. Charting a future: process and promise. Proceedings of the Vertebrate Pest Conference 16: 5-8.

Adams, C. E., K. J. Lindsey, and S. J. Ash. 2006. Urban wildlife management. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.

Andrews, E., B. T. Bennett, J. D. Clark, K. A. Houpt, P. J. Pascoe, G. W. Robinson, and J. R. Boyce. 1993. Report of the AVMA panel on euthanasia. Journal of the American Veterinary Medical Association 202:229-249.

Associated Market Research. 1991. Pest control operators nuisance animal business survey report. Unpublished Report, Associate Market Research, Middleburg Heights, Ohio, USA.

Barnes, T. G. 1998. State agency response to nuisance wildlife control oversight. Proceedings of the Vertebrate Pest Conference 18:287-289.

Barnes, T. G. 1997. State agency oversight of the nuisance wildlife control industry. Wildlife Society Bulletin 25:185-188.

Barnes, T. G. 1995. Survey of the nuisance wildlife control industry with notes on their attitudes and opinions. Pages 104-108 *in* R. E. Masters and J. G. Huggins, editors. Twelfth Great Plains Wildlife Damage Control Workshop Proceedings. Noble Foundation, Ardmore, Oklahoma, USA.

Barnes, T. G. 1993. A survey comparison of pest control and nuisance wildlife control operators in Kentucky. Proceedings of the Eastern Wildlife Damage Control Conference 6:39-48.

Beaver, B. V., W. Reed, S. Leary, B. McKiernan, F. Bain, R. Schultz, B. T. Bennett, P. J. Pascoe, E. Shull, L. C. Cork, R. Francis-Floyd, K. D. Amass, R. Johnson, R. H. Schmidt, W. Underwood, G. W. Thornton, and B. Kohn. 2001. Report of the AVMA panel on euthanasia. Journal of the American Veterinary Medical Association 218:669-696.

Bergman, D. L., M. D. Chandler, and A. Locklear. 2000. The economic impact of invasive species to Wildlife Services' cooperators. Proceedings of the National Wildlife Research Center Special Symposium 3:169-178.

Berryman, J. H. 1992. The complexities of implementing wildlife damage management. Transactions of the North American Wildlife and Natural Resource Conference 57:47-50.

Bluett, R. D., G. F. Hubert, Jr., and C. A. Miller. 2003. Regulatory oversight and activities of wildlife control operators in Illinois. Wildlife Society Bulletin 31: 104-116.

Bollengier, R. M. 1987. State/federal/private cooperative program relationships in wildlife damage control. Proceedings of the Eastern Wildlife Damage Control Conference 3:307-308.

Braband, L. A. 1995. The role of the nuisance wildlife control practitioner in urban wildlife management and conservation. Proceedings of the Eastern Wildlife Damage Control Conference 6:138-139.

Brammer, T. J., P. T. Bromley, and R. Wilson. 1994. The status of nuisance wildlife policy in the United States. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 48:331-335.

Bromley, P. T., C. Betsill, R. Cannon, J. F. Hiesterberg, E. J. Jones, W. T. Sullivan, P. Sumner, R. C. Wilson, and D. D. Woodward. 1993. Opportunities and challenges in handling nuisance wildlife damage in North Carolina. Proceedings of the Eastern Wildlife Damage Control Conference 6:20-21.

Christman, B. 2003. Partner for nuisance wildlife control. Pest Control 71:36.

Clark, K. D. 2003. The private sector's involvement in wildlife control. Transactions of the North American Wildlife and Natural Resource Conference 68:266-275.

Cleary, E. C, and R. A. Dolbeer. 2005. Wildlife hazard management at airports: a manual for airport personnel. U.S. Department of Transportation, Federal Aviation Administration and U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Washington, D.C., USA.

Conover, M. 2002. Resolving human-wildlife conflicts: the science of wildlife damage management. Lewis Publishers, Boca Raton, Florida, USA.

Conover, M. 1997. Wildlife management by metropolitan residents in the United States: practices, perceptions, costs, and values. Wildlife Society Bulletin 25:306-311.

Craven, S., T. Barnes, and G. Kania. 1998. Toward a professional position on the translocation of problem wildlife. Wildlife Society Bulletin 26:171-177.

Craven, S. R., D. J. Decker, W. F. Siemer, and S. E. Hygnstrom. 1992. Survey use and landowner tolerance in wildlife damage management. Transactions of the North American Wildlife and Natural Resource Conference 57:75-87.

Critter Control. 2005. Business opportunities in urban wildlife management. Critter Control, Traverse City, Michigan, USA.

Critter Control. 2003. Business opportunities in urban wildlife management. Critter Control, Traverse City, Michigan, USA.

Critter Control. 1991. Critter Control calls for licensing NWCOs. Critter Chatter 1:1-2.

Cunningham, A. A. 1996. Disease risks of wildlife translocations. Conservation Biology 10:349-353.

Curtis, P. D., M. E. Richmond, P. A. Wellner, and B. Tullar. 1995. Characteristics of the private nuisance wildlife control industry in New York. Proceedings of the Eastern Wildlife Damage Control Conference 6:49-57.

Curtis, P. D., and D. J. Decker. 1990. Wildlife damage management needs in New York State: perceptions of Cornell Cooperative Extension agents. H.Y.S. College of Agriculture and Life Science, Department of Natural Resources, Cornell University, Ithaca, New York, USA.

Decker, D. J. 1987. Management of suburban deer: an emerging controversy. Proceedings of the Eastern Wildlife Damage Control Conference 3:344-345.

Fedriani, J. M., T. K. Fuller, and R. M. Sauvajot. 2001. Does availability of anthropogenic food enhance densities of omnivorous mammals? An example with coyotes in southern California. Ecography 24:325-331.

FHWAR. 2001. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. U.S. Census Bureau, U.S. Department of Commerce, Washington, D.C., USA.

Flyger, V., D. L. Leedy, and T. M. Franklin. 1983. Wildlife damage control in Eastern cities and suburbs. Proceedings of the Eastern Wildlife Damage Control Conference 1:27-32.

Hadidian, J., L. J. Simon, and M. R. Childs. 2002. The "nuisance" wildlife control industry: animal welfare concerns. Proceedings of the Vertebrate Pest Conference 20:378-382.

Hadidian, J., M. R. Childs, R. H. Schmidt, L. J. Simon, and A. Church. 2001. Nuisance-wildlife control practices, policies, and procedures in the United States. Pages 165-168 in R. Field, R. J. Warren, H. Okarma, and P. R. Sievert, editors. Wildlife, land, and people: priorities for the 21st century. The Wildlife Society, Bethesda, Maryland, USA.

Harris, S., and J. M. V. Rayner. 1986. Urban fox (*Vulpes vulpes*) population estimates and habitat requirements in several British cities. Journal of Animal Ecology 55:575-591.

Kotler, P. 2006. A framework for marketing management. Prentice Hall, Upper Saddle River, New Jersey, USA.

La Vine, K., M. J. Reeff, J. A. DiCamillo, and G. S. Kania. 1996. The status of nuisance wildlife damage control in the states. Proceedings of the Vertebrate Pest Conference 17:8-12.

Lindsey, K. J., and C. E. Adams. 2006. Public demand for information and assistance at the human-wildlife interface. Human Dimensions of Wildlife 11:267-283.

Louv, R. 2005. Last child in the woods: saving our children from nature deficit disorder. Algonquin Books, Chapel Hill, North Carolina, USA.

Madison, L. A., and P. S. Gipson. 1997. Wildlife damage control in Kansas: private operators and public agencies. Proceedings of the Eastern Wildlife Damage Control Conference 7:44-49.

Manski, D. A., L. W. Van Druff, and V. Flyger. 1981. Activities of gray squirrels and people in a downtown Washington, D.C. park: management implications. Transactions of the North American Wildlife and Natural Resources Conference 46:439-454.

McAninch, J. B. 1991. Wildlife damage management in the 90s: does the professional fit the profession? Pages 171-174 in S. E. Hygnstrom, R. M. Case, and R. J. Johnson, editors. Tenth Great Plains Wildlife Damage Control Workshop Proceedings. University of Nebraska-Lincoln, Nebraska, USA.

McKegg, J. S. 1984. Maryland's wildlife control cooperator program. Wildlife Society Bulletin 12:414-416.

McKinney, M. L. 2002. Urbanization, biodiversity, and conservation. Bioscience 52:883-890.

Messmer, T. A. 2000. The emergence of human-wildlife conflict management: turning challenges into opportunities. International Biodeterioration & Biodegradation 45:97-102.

Mosillo, M., E. J. Heske, and J. D. Thompson. 1999. Survival and movements of translocated raccoons in north-central Illinois. Journal of Wildlife Management 63:278-286.

Organ, J. F., and M. R. Ellingwood. 2000. Wildlife stakeholders acceptance capacity for black bears, beavers, and other beasts in the east. Human Dimensions of Wildlife 5:63-75.

Pomerantz, G. A. 1985. The influence of "Ranger Rick" magazine on children's perceptions of natural resource issues. Dissertation, North Carolina State University, Raleigh, North Carolina, USA.

Prange, S., S. D. Gehrt, and E. P. Wiggers. 2003. Demographic factors contributing to high raccoon densities in urban landscapes. Journal of Wildlife Management 67:324-333.

Rowcliffe, J. M., E. de Merode, and G. Cowlishaw. 2004. Do wildlife laws work? Species protection and the application of a prey choice model to poaching decisions. Proceedings of the Royal Society – Biological Sciences 271:2631-2636.

Rupprecht, C. E., and J. S. Smith. 1994. Raccoon rabies: the re-emergence of an epizootic in a densely populated area. Seminars in Virology 5:155-164.

San Julian, G. J. 1987a. The future of wildlife damage control in an urban environment. Proceedings of the Eastern Wildlife Damage Control Conference 1:229-233.

San Julian, G. J. 1987b. Extension's perspective of federal, state, and private animal damage control programs. Proceedings of the Eastern Wildlife Damage Control Conference 3:312-313.

Schmidt, R. H. 1998. Required knowledge. Wildlife Control Technology 5:6-7.

Slate, D., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. Transactions of the North American Wildlife and Natural Resources Conference 57:51-62.

Snetsinger, R. 1983. The ratcatcher's child: the history of the pest control industry. Franzak and Foster Co., Cleveland, Ohio, USA.

Sterba, J. P. 2002. With trappers' hands tied, 'wildlife damage control' becomes a big business. Wall Street Journal (Eastern edition). May 21, 2002, section A-1.

U.S. Bureau of Labor Statistics. 2007. Pest control workers. http://www.bls.gov/oco/ocos254.htm, accessed 6 June 2007.

U.S. Census Bureau. 2007. Glossary of decennial census terms and acronyms. http://www.census.gov/dmd/www/glossary.html, accessed 2 April 2007.

U.S. Census Bureau. 2006. Persons per square mile. U.S. Department of Commerce, Washington, D.C., USA.

U.S. Census Bureau. 2003. Population in metropolitan and micropolitan statistical areas sorted in alphabetical order and numerical and percent change for the United States and Puerto Rico: 1990 and 2000. U.S. Department of Commerce, Washington, D.C., USA.

U.S. Census Bureau. 2002. Table 10, statistics for all U.S. firms by major industry group. U.S. Department of Commerce, Washington, D.C., USA.

U.S. Census Bureau. 2000. Census 2000 summary file 2 (SF 2) 100-percent data, geographic comparison tables. U.S. Department of Commerce, Washington, D.C., USA.

U.S. Census Bureau. 1997. Persons per square mile. U.S. Department of Commerce, Washington, D.C., USA.

U.S. Census Bureau. 1990. Census 1990 summary tape file 3 (STF 3) 100-percent data, geographic comparison tables. U.S. Department of Commerce, Washington, D.C., USA.

Whitford, M. 2007. Fortune hunter. Pest Control 75:86-91.

Wildlife Services. 2004. Wildlife Services: resolving conflicts between people and wildlife. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Washington, D.C., USA.

Williams, O., and J. McKegg. 1987. Nuisance furbearer management programs for urban areas. Pages 156-163 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Mallock, editors. Wild furbearer management and conservation in North America. Ministry of Natural Resources, Peterborough, Ontario, Canada.

Winter, M. 1999. Deer ahead! ALS NEWS, Cornell University, College of Agriculture and Life Sciences, Ithaca, New York, USA.

Wright, R. T., and B. J. Nebel. 2002. Environmental science: toward a sustainable future. Prentice-Hall, Inc., Upper Saddle River, New Jersey, USA.

APPENDIX A

SUMMARY OF NWC BUSINESS DATABASE

State	# of NWC Businesses	State	# of NWC Businesses	State	# of NWC Businesses
AK	4	KY	59	NY	140
AL	23	LA	14	OH	103
AR	25	MA	151	OK	34
AZ	27	MD	42	OR	50
CA	126	ME	7	PA	92
CO	39	MI	452	RI	14
CT	153	MN	32	SC	69
DC	6	MO	48	SD	3
DE	6	MS	11	TN	34
FL	375	MT	6	TX	72
GA	139	NC	101	UT	8
HI	4	ND	2	VA	53
IA	49	NE	12	VT	13
ID	7	NH	35	WA	34
IL	167	NJ	86	WI	58
IN	92	NM	14	WV	7
KS	50	NV	5	WY	0

APPENDIX B

ESTIMATED ANNUAL 2007 NWC INDUSTRY SALES

		Method I			Method II		
State	Reg.	Demand	Sales	Region Sales Total	Demand	Sales	Region Sales Total
AK	1	181	54246		600	180000	
CA	1	5153	1546011		18900	5670000	
HI	1	181	54246		600	180000	
NV	1	181	54246		750	225000	
OR	1	1989	596706		7500	2250000	
WA	1	1356	406845	2712300	5100	1530000	10035000
AZ	2	520	155925		4050	1215000	
CO	2	732	219450		5850	1755000	
ID	2	135	40425		1050	315000	
MT	2	116	34650		900	270000	
NM	2	270	80850		2100	630000	
UT	2	154	46200		1200	360000	
WY	2	0	0	577500	0	0	4545000
IA	3	270	80925		7350	2205000	
KS	3	281	84162		7500	2250000	
MN	3	173	51792		4800	1440000	
MO	3	259	77688		7200	2160000	
ND	3	21	6237		300	90000	
NE	3	65	19422		1800	540000	
SD	3	22	6474	326700	450	135000	8820000
AR	4	1361	408306		3750	1125000	
LA	4	801	240180		2100	630000	
OK	4	1841	552414		5100	1530000	
TX	4	4003	1200900	2401800	10800	3240000	6525000
IL	5	1319	395751		25050	7515000	
IN	5	764	229119		13800	4140000	
MI	5	3610	1083108		67800	20340000	
OH	5	833	249948		15450	4635000	
WI	5	417	124974	2082900	8700	2610000	39240000
AL	6	252	75492		3450	1035000	
KY	6	643	192924		8850	2655000	
MS	6	126	37746		1650	495000	
TN	6	377	113238	419400	5100	1530000	5715000
CT	7	1580	473919		22950	6885000	
MA	7	1541	462360		22650	6795000	
ME	7	77	23118		1050	315000	
NH	7	347	104031		5250	1575000	
RI	7	154	46236		2100	630000	
VT	7	154	46236	1155900	1950	585000	16785000
NJ	8	488	146367		12900	1754400	

		Method I			Method II		
State	**Reg.**	**Demand**	**Sales**	**Region Sales Total**	**Demand**	**Sales**	**Region Sales Total**
NY	8	795	238524		21000	6300000	
PA	8	524	157209	542100	13800	4140000	12194400
DC	9	75	22455		900	270000	
DE	9	75	22455		900	270000	
FL	9	3518	1055385		56250	16875000	
GA	9	1272	381735		20850	6255000	
MD	9	374	112275		6300	1890000	
NC	9	973	291915		15150	4545000	
SC	9	599	179640		10350	3105000	
VA	9	524	157185		7950	2385000	
WV	9	75	22455	2245500	1050	315000	35910000
Totals		41547		12464100	472950		139769400

APPENDIX C

REGULATORY SCORING DATA FOR 1997 AND 2007

	License		Prereq.		Recertify		Report		Translocation		Euthanasia		Humane Guidelines		Threshold of Damage		Consumer Protection		IPM		Total	
	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07
AK	0	1	0	.5	0	0	0	1	0	1	0	.5	0	0	0	1	0	0	1	0	1.0	5.0
AL	0	0	0	0	0	0	0	0	0	1	0	0	0	0	.5	1	0	0	0	0	0.5	2.0
AR	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	.5	0	0	0	0	0.0	1.5
AZ	1	1	0	.5	.5	0	1	1	1	1	0	0	1	.5	0	.5	0	0	0	0	4.5	4.5
CA	0	0	0	0	0	0	0	0	1	1	.5	.5	0	0	0	0	0	0	0	0	1.5	1.5
CO	0	0	0	0	0	0	0	0	0	1	0	0	0	.5	0	0	0	0	0	0	0	1.5
CT	1	1	1	1	0	0	1	1	1	1	1	1	.5	.5	0	0	1	1	0	.5	6.5	7.0
DC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
DE	1	1	0	.5	0	0	1	1	1	1	.5	0	0	.5	0	0	0	0	0	.5	3.5	4.5
FL	1	.5	0	0	0	0	0	0	0	0	0	.5	0	0	0	0	0	0	0	0	0	1.0
GA	1	1	0	.5	0	0	1	1	0	1	.5	.5	1	1	0	0	0	0	0	0	3.5	5.0
HI	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	.5	0	0	.5	.5	1.5	3.0
IA	0	1	0	.5	0	0	0	1	0	1	0	.5	0	.5	0	.5	0	1	0	1.0	0	7.0
ID	0	1	0	0	0	0	0	1	0	1	0	0	0	0	.5	.5	0	0	0	0	0.5	3.5
IL	1	1	.5	.5	0	0	1	1	1	1	.5	.5	1	1	.5	1	1	1	0	0	6.5	7.0
IN	1	1	0	.5	0	1	1	1	1	1	0	.5	0	1	0	.5	0	0	0	.5	3.0	7.0

	License		Prereq.		Recertify		Report		Translocation		Euthanasia		Humane Guidelines		Threshold of Damage		Consumer Protection		IPM		Total	
	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07
KS	0	1	0	1	0	0	0	1	0	1	0	.5	0	.5	0	1	0	.5	0	0	0	6.5
KY	1	1	0	.5	0	0	0	1	0	1	0	.5	0	.5	0	0	0	0	0	0	0	4.5
LA	1	1	.5	.5	0	0	1	1	1	1	.5	1	.5	.5	0	.5	0	0	0	.5	4.5	6.0
MA	1	1	.5	.5	1	.5	1	1	1	1	.5	.5	0	0	0	.5	1	1	.5	.5	6.5	6.5
MD	1	1	.5	.5	0	0	1	1	1	1	0	.5	0	0	0	0	0	0	0	0	3.5	4.0
ME	0	1	0	0	0	1	1	1	1	1	0	.5	0	.5	.5	1	0	0	1	1	3.5	7.0
MI	1	1	0	0	0	0	1	1	1	1	1	1	.5	.5	0	1	1	0	1	.5	6.5	6.0
MN	0	1	0	0	0	0	0	1	0	1	0	.5	0	.5	0	1	0	0	.5	0	0.5	5.0
MO	0	0	0	0	0	0	0	0	0	1	0	0	0	.5	0	1	0	0	0	0	0	2.5
MS	0	1	0	.5	0	0	0	1	0	1	0	0	0	.5	.5	0	0	0	0	.5	0.5	4.5
MT	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1.0
NC	1	1	1	1	1	1	1	1	1	1	.5	.5	.5	.5	.5	.5	0	.5	0	.5	6.5	7.5
ND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	1	0	0	0	0	0	1	0	1	0	.5	0	.5	0	1	0	0	0	0	0	5.0
NH	0	1	0	1	0	1	0	1	0	1	0	.5	0	.5	1	0	0	0	0	.5	1.0	6.5
NJ	0	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	.5	.5	3.5	5.5

	License		Prereq.		Recertify		Report		Translocation		Euthanasia		Humane Guidelines		Threshold of Damage		Consumer Protection		IPM		Total	
	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07
NM	0	.5	0	0	0	0	0	1	1	1	.5	0	0	.5	0	0	0	0	0	0	1.5	3.0
NV	1	1	0	.5	0	0	1	1	1	1	.5	.5	0	0	0	0	0	0	0	0	3.5	4.0
NY	1	1	0	.5	0	0	1	1	1	1	.5	.5	.5	.5	0	1	0	1	0	1	4.0	7.5
OH	1	1	0	0	0	0	.5	.5	1	1	.5	.5	0	0	0	0	0	0	0	0	3.0	3.0
OK	0	1	0	.5	0	0	0	1	0	1	0	1	0	0	0	.5	0	1	0	.5	0	6.5
OR	0	1	0	.5	0	0	0	1	0	1	0	1	0	.5	.5	.5	0	0	0	0	0.5	5.5
PA	0	1	0	.5	0	0	.5	1	1	0	0	.5	0	.5	0	0	0	0	.5	0	2.0	3.5
RI	1	1	0	.5	0	0	0	1	1	1	.5	1	0	.5	0	0	0	0	0	0	1.5	5.0
SC	0	0	0	0	0	0	1	0	0	1	0	0	0	0	.5	.5	0	.5	0	.5	1.5	2.5
SD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TN	1	1	.5	.5	0	0	1	1	1	1	.5	.5	.5	.5	.5	0	1	1	0	0	6.0	5.5
TX	0	0	0	0	0	0	0	0	1	1	0	0	.5	0	0	0	0	1	0	0	1.5	2.0
UT	0	.5	0	0	0	0	0	1	1	1	0	.5	0	0	0	0	0	0	0	0	1.0	3.0
VA	0	1	0	.5	0	1	0	1	0	1	0	.5	0	.5	0	0	0	1	0	0	0	6.5
VT	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	.5	0	0	0	0	1.0	1.5
WA	1	1	.5	1	0	0	1	1	1	1	.5	.5	.5	.5	.5	.5	0	.5	.5	.5	5.5	6.5

	License		Prereq.		Recertify		Report		Translocation		Euthanasia		Humane Guidelines		Threshold of Damage		Consumer Protection		IPM		Total	
	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07	'97	'07
WI	0	0	0	.5	0	0	0	.5	0	1	0	0	0	0	0	.5	0	0	.5	.5	0	3.0
WV	1	1	.5	.5	1	1	1	1	1	1	.5	.5	0	0	0	0	1	1	.5	0	6.5	6.0
WY	0	1	0	0	0	0	0	1	0	1	0	.5	0	.5	0	.5	0	0	0	0	0	4.5
TTL	20.0	35.5	6.5	16.0	3.0	6.5	20.0	37.0	25.0	46.0	10.5	20.0	8.0	16.5	6.0	18.0	6.0	12.0	7.0	10.5	112	218
AVG	0.39	0.70	0.13	0.31	0.06	0.13	0.39	0.73	0.49	0.90	0.21	0.39	0.16	0.32	0.12	0.35	0.12	0.24	0.14	0.21	2.20	4.27

APPENDIX D

NOMENCLATURE

AAGR	Average Annual Growth Rate
ADC	Animal Damage Control
ANOVA	One-way Analysis of Variance
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BLS	U.S. Department of Labor Bureau of Labor Statistics
CES	Cooperative Extension Service
CSREES	Cooperative State Research, Education, and Extension Service
DNR	Department of Natural Resources
FHWAR	National Survey of Fishing, Hunting and Wildlife-Associated Recreation
FWS	U.S. Department of the Interior Fish and Wildlife Service
GDP	Gross Domestic Product
HSUS	Humane Society of the United States
IPM	Integrated Pest Management
MIS	Management Information System
MSA	Metropolitan Statistical Area
NADCA	National Animal Damage Control Association
NGO	Non-governmental Organization
NUWMA	National Urban Wildlife Management Association
NWC	Nuisance Wildlife Control
NWCO	Nuisance Wildlife Control Operators
NWCOA	National Wildlife Control Operators Association
USDA	United States Department of Agriculture
WS	U.S. Department of Agriculture Wildlife Services

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